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Growth and Decay of the Mexican Plateau

Changes of Temperature and the Action of the Wind Wear Away and Carry Rock Material into the Sea, Gradually Lowering the Land Mass

BY ROBERT T. HILL*

No portion of the American continent is so interesting in its natural features, so entrancing to the observer of phenomena in all their applications, and so difficult of explanation as the narrowing southern end of the great Cordilleran region, known as the Mexican plateau. This region lies mostly within the Republic of Mexico, but it also extends to the north across our southern borders. In papers of recent years I have endeavored to give some definitions and descriptions of the salient characteristic features of its marvelous geography and geology. For years I have studied this great area and have arrived at deductions and generalizations which I shall endeavor to express by a pen picture, unaccompanied by the vast burden of details upon which the conclusions are based.

PILED UP PEAK OF ORIZABA, ALTITUDE 18,325 FEET RISING FROM EASTERN EDGE OF MEXICAN PLATEAU, ALTITUDE 8000 FEET

The striking geographic features of the Mexican region, as seen by studying the map, are its (1) cornucopiate outlines; (2) the vastly larger proportionate area of elevated mountainous interior than that of the adjacent coastal plains; (3) the narrow coastal plains themselves, one of which, on the east (the Gulf Coastal Plain) is constructional (composed of elevated sea-bordered deposits) and one on the west degraded (destructional, representing the worn down former extent of the plateau); (4) the large central plateau with its varied configuration of eastern, western and southern sierras, and the numerous lost mountains of the central deserts; (5) the great volcanic piles of the south built above the plateau. Other notable geographic features are the origin and disposition of the drainage and many peculiar surface details of the land.

Geologic Features

The striking geologic features of Mexico under the four heads of material, structure, process and history are as follows:

The material, notwithstanding its apparently infinitely varied manifestations, groups itself into four principal kinds: (1) marine sedimentaries, largely of Mesozoic age and mostly Cretaceous, with the exception of some spots of Triassic, Jurassic and Paleozoic rocks in Sonora and Puebla; (2) igneous (intrusive and eruptive) rocks; (3) ore deposits; and (4) surficial deposits, made up of many kinds of débris, and *tepetate*, etc., which remain over the surface in various peculiar formations.[1]

The geologic processes of the plateau, past and present, are represented in the interesting aspects of rock folding, faulting, continental uplift, volcanic pile-up and degradation, all manifested in an unusual degree and with curious detail.

The salient features of the geologic history pertain to the obscurity of knowledge of the beginnings before Mesozoic time, the older rocks being mostly concealed by the vast Cretaceous and eruptive mantles; the comparative recentness of the great geologic events and the stupendousness of the present geologic operations of growth and decay.

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[1] "Some Peculiar Formations of the Arid Region," ENG. AND MIN. JOURN., April 6, 1907.

Except in the Sonoran province and the extreme south where the Paleozoic rocks are alone exposed, all the visible material of the vast mass have been practically made since near the close of the Jurassic period; and all that marvelous massive geologic work producing the outlines above sea level as we now see them, was accomplished practically since the close of the Cretaceous period, during which the oceans covered the site.

Beginnings of the Plateau

In what manner this remarkable area first appeared as land above the sea has not been deciphered. We know that in Cretaceous time the ocean sediments now forming the shales and limestones, constituting the chief stratified rock of the Republic, were being deposited and that most of the present area was then under Atlantic water.

folded, in some instances overthrown and folded into recumbent flexures, Alpine in their complexity. Of this folding we know that it was intense and complicated in the latitude of the southern area where it is so involved that it will ever be beyond human power to work out the details. Furthermore, the stresses were so intense as to convert many of the Cretaceous and probably older rocks into schists and marbles.

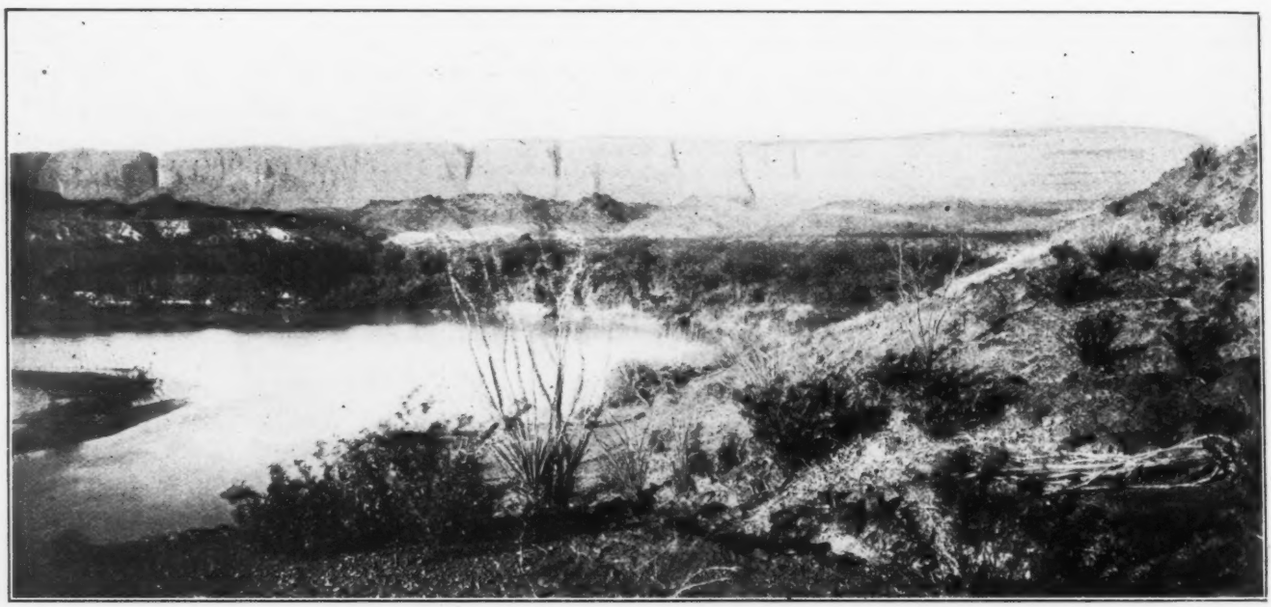
The folding of the strata of Mexico, produced by some great strain of the earth's crust, was from the west eastward, as recorded by the great recumbent anticlines with the arches of their folds pointing toward the Atlantic, and seen in the Sierra Almoloya, at Juarez and elsewhere.

How much the region was elevated above the ocean by this Rocky mountain or Laramide epoch of folding is still a

and precious metals, from the earth's interior to its sub-surface and exterior since Cretaceous time until the present.

The human mind is incapable of conceiving the great quantities of matter which have thus been piled up. The gigantic ash and lava heaps constituting the mountain masses of Orazaba, Popocatepetl, Ixtacihuatl, Ajusco, Toluco and Colima, great self-built cones rising 10,000 ft. above the plateau, give but a faint idea of the totality of the matter which has been extruded, for vastly greater quantities of this extruded matter have been eroded away than now remains upon the surface.

The lava caps of El Oro and Guanajuato; the "bufas" of Chihuahua; the necks and dikes scattered everywhere over Mexico are but fragmental wrecks of the igneous material which has forced its way toward and to the surface and



GREAT FAULT SCARP OF SANTA HELENA, CHIHUAHUA

The prehistoric borders of the Gulf of Mexico are recorded by fossils as far west as Bisbee and Sahuaripa; and even deeper waters of the Gulf of Mexico extended to what is now the present coast of the Pacific in the State of Colima.

Yet we also know that in this Cretaceous period there was somewhere a land barrier between the Pacific and the Atlantic, probably west of the main area of present Mexico, because the forms of life in the Pacific and Atlantic oceans as recorded by the entirely synchronous fossils of the Cretaceous in California and Texas rocks, contain not one species in common.

Fold-Up

At the close of the Cretaceous period and in early Tertiary time, the muds of the Cretaceous seas began to undergo compression and squeezing until in places they were most compactly and closely

subject for research. But it is known that the raising of the plateau into its present hights was not coincident with this event but due to later movement, as will be hereafter explained.

Intrusion and Pile-Up

Differentiated from the great *proto magma*[1] of the earth's interior beneath the plexus of folded rocks, igneous magmas, ever seeking outlets, have penetrated upward into the sedimentary crust of the plateau and, finding outlet, have buried the surface with vast loads of volcanic ejecta. These magmas through vents have been performing their work of transporting material, ash, lava, steam

which has mostly been degraded away. The plateau of the western Sierra Madre, the Davis mountains of Texas, the Mogollons of New Mexico, are extensive remnantal areas of the great vast piles which once extended over most of the plateau. The western Sierra Madre alone presents a pile of volcanic ash, averaging 300 miles in length by 100 in width and a mile in depth; and yet this is but a fragment of its former area, which has been and is constantly being restricted on every side by erosion.

The surface ejecta of today convey but a faint idea of the vast work of the underground roots of volcanism, which as dikes, necks, sills everywhere push into and underlie the sub-structure, and which are here and there exposed by denudation. The deeper seated rocks, granites, etc., are seldom exposed, and even these are largely of later geologic periods.

[1] A term proposed by the author for the great, unkown, universal matter of the earth's interior from which all the chemical elements and combinations, including rock magmas are derived. *Bulletin* Geological Society of America; Vol. 16, p. 283.

The Cordilleran Peneplain

One of the greatest factors in producing the present altitude of the plateau, and one which is the least appreciated, is the geologic process of continental elevation or uplift, whereby the whole region has been elevated bodily as distinguished from fold-up and pile-up. The subjects of uplift and subsidence are so involved in hypothesis and so different in popular presentation that I hesitate to touch upon them.

Yet there is considerable evidence that after the first evolution of the Mexican plateau and the whole American Cordilleran region from the sea, and the attainment of considerable hight of land, it was degraded down to nearer sea level than at present by erosion, so that its surface was still irregular but not so rough as now. For this old hypothetical degraded land surface, the remnants of which constitute the present highest tops of the plateau as distinguished from the more recent volcanic piles, we can provisionally use the name Cordilleran peneplain.

After the land had been planed down to near sea level there followed a great continental uplift, which may be still going on so far as we are aware, and which gave the plateau an additional altitude of from 5000 to 10,000 ft., and even greater extension to the westward than it now possesses. The fragments of this uplifted peneplain constitute the present high mountainous tops of the plateau. This uplift has been very recent in geologic time, and may be still going on.

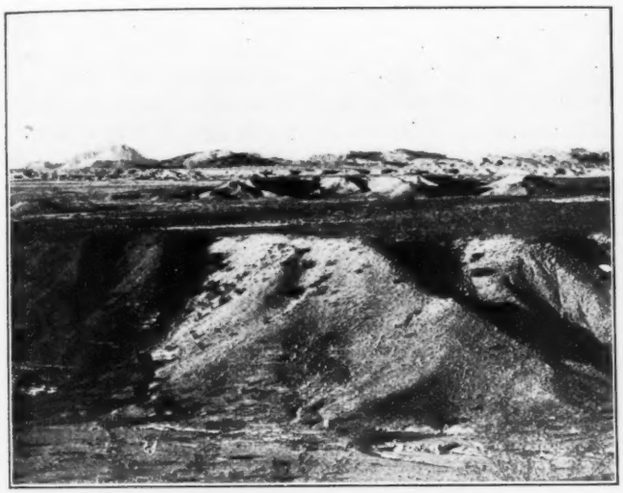
If the mining engineer or geologist is sufficiently interested in this subject to observe it further in his travels, he can do so by visiting and comparing the Grand Cañons of the Colorado in Arizona, the Rio Grande, or of the Fuerte, the Aros in the western Sierra Madre, the Cañon of Lerma (Rio Grande de San Francisco) in Guadalajara, and the valley of the Balsas, which separates the Sierra del Sur from the southern end of the plateau. In each of these he will see great eroded streamways incised a mile in depth beneath the plateau top, recording the uplift of the plateau land across the streamways 5000 ft. or more.

Faulting and Structural Trends

One cannot well conceive of the movements of compression and uplift without realizing that they were accompanied by vast strains and breaks of the type known as faults. The great fault systems dominate many physical features such as the trends of the ranges, scarps and valleys, the direction of streams, and, above all, the occurrence of mineral lodes which have been deposited in their fissures.

The fault systems are still a subject for study and the accumulation of records; but sufficient light is dawning to enable us to see that there were several trends and systems made in different epochs of time, each with a prevailing direction, and crossing one another at various intersecting points. The oldest of those which have come under my observation, is the north-south system (Rocky mountain trend) recorded in the direction of the mountain blocks of south central New Mexico. The traveler as he enters the north gate of Mexico at El Paso, can see one of these faults along the east face of Mount Franklin, with a downthrow of 10,000 ft., more or less. A later and the most conspicuous system (the Mexican trend) is the west-of-north faults and fractures coincident with so many of the vein systems of the republic and which constitutes the dominant continental trend of the plateau.

Still another system (the Antillean), suspected and almost known, is a still more northwest-southeast line of recent movement, the curving axis of which



WIND WORK IN THE DESERT—LOWER TERRACE OF RIVER GRAVEL

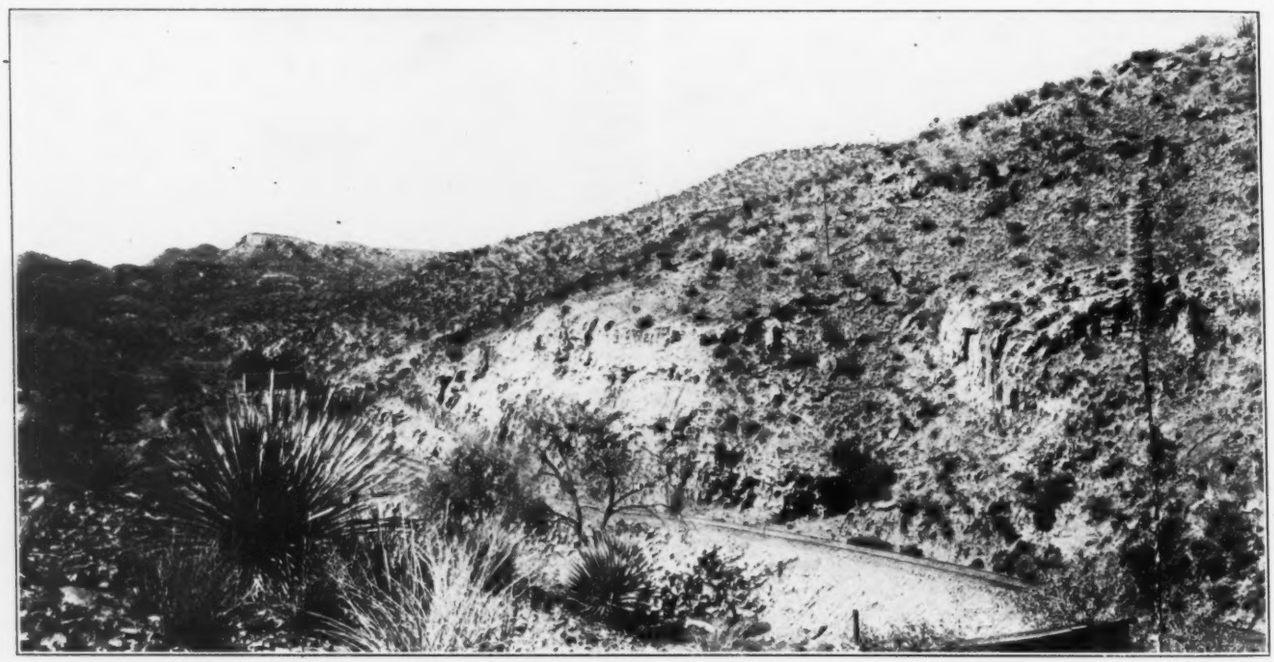
CLIFFS UNDERMINED BY WIND ACTION

RECUMBENT ALPINE FOLD OF THE SIERRA ALMOLOYA

DUST OF THE DESERT, POWDERED MOUNTAIN ROCK

corresponds to the trend of the Pacific coast, and can be plotted on three points recently in the public eye on account of seismic incidents, San Francisco, Chilpancingo and Kingston, Jamaica. This trend in its southern extension assumes a more easterly direction, and many have hypothetically maintained that the abrupt termination of the plateau at its southern end and the east-west belt of crater piles of the Mexican volcanic highland, is due to the displacements of this system.

While each of these fault systems is most manifest in some particular district, each also occurs in a wide zone and is crossed by or interfered with in places by another. Owing to this fact there are certain localities where the crossings of the trends have been severe in their effects, like Southern California at the end of the Sierras; at El Paso, where the



FOLD-UP ON RIGHT-GRAVITY TALUS ON LEFT-PLATEAU CONTRACTED BY DEGRADATION

Paleozoic area with its north-south faults has been cut down and out to the southward by the northwest-southeast faults; at Almoloya, Monterey and throughout Northeast Mexico, where the north-south, northwest-southeast and east-west trends have created confusion, and the southern end of Mexico where the east-west trends cut out the northwest-southeast system.

Another effect of the crossing of the fault and deformation trends has been the production of the remarkable quaquaversal mountains of Northern Mexico, as I have recently shown.[1] Intersections of these systems may also be found to coincide with many ore occurrences.

Mineralization

The stratified and igneous rocks of Mexico with their diversity of fracture planes, produced by the movements described, their solubility, porosity and conduits for circulation of waters and magmas, constitute the matrix for a wide distribution and occurrence of its many minerals. All of the minerals owe their origin to the great magmas, which from time to time have welled up from below, cooled and differentiated. Although science as yet has neither completely nor exactly determined the laws of how the metals are differentiated from the other ingredients of the magmas, rapidly accumulating data of recent years have so completely demonstrated their close association and relation, that the adherents of the ground-water theory can find but little support in this region except where water chiefly plays the secondary part of alteration of the vein or orebody *in situ*.

The primary source of Mexico's minerals is the intensity of its volcanism in past times and its magnificent fracture systems. Kemp, Weed, Spurr and others have in recent papers shown much of the relation of igneous and metallic phenomena. The details of this mineralization must be left to more specific papers.

Destruction

We have now outlined the material and how the great plateau has been built up above the sea. But the familiar aspects of the surface, with the exception of the still growing volcanic piles at the south, are not the products of upbuilding but of destruction; for nature has long been and is now tearing down that which she has built up and is again reducing the hights to sea level. The first thing necessary in endeavoring to understand the physiographic phenomena of Mexico is to cultivate a frame of mind to appreciate the vast removal of material which has taken place, and that on every side there are evidences of this destruction visible in the mountain talus, the desert gravel and dirt and even in the mountains themselves, which, save in the exceptional instances mentioned, are destructional decaying forms, representing merely the survival of the hardest in the general wearing down of what was once higher and entirely different land.

It is the universal habit to look upon mountains as built-up forms, as cloud-capped peaks rearing their pinnacles to the sky, etc., when, in fact, they are mostly ruins, fragments, stubs and remnants of a once higher and vastly different physiography, the ever crumbling and degrading remnants of once greater masses of rock which will soon, in geologic time at least, be worn down to the general level of the plains from which they rise. Not only the great barrancas, cañons and the desert valleys, but also the remnantal disconnected mountains, the cliffs, scarps and mesas and the so-called "throw-ups," "upheavals," and blow-outs are all testimonials of the former extension of material and its removal.

The region as an entirety even in its deserts below sea level, may be considered as the decaying and lowering remnant of the vast uplifted Cordilleran peneplain, which is always rapidly degrading down toward sea level. So extensive has been this degradation that only here and there are left islands, spots of the older highlands, like the vast mountain groups of the Sierra Nevada, the Uintas, the Rockies, the Sacramentos, the Mogollons, the Western Sierra Madre and the Sierra

[1] *Science*, May 5, 1907, pp. 310-312.

Madre del Sur. Even the tops of these great ranges do not represent the original surfaces, however; but are the worn-down remnants of masses which once had still higher extension toward the sky.

The lateral extent of the plateau has also been largely destroyed, so that its former extension westward over the Sonoran province is base-leveled toward the sea; its former western scarp has receded far eastward, and the old fundamental Paleozoic rocks have been exposed. Thousands of feet of strata and igneous rock have also been denuded from the great Chihuahuan province.

Peculiarities of Surface Conditions

The surface phenomena of arid America, as seen in the general aspects and contours of the landscape and soil are entirely different from those of humid regions. These exhibit themselves in several important phases, such as the peculiarities of weathering, induration and disintegration of the rock surfaces, the small oxidizing effect of the scarce rainfall upon the sub-surface, and the peculiar mode of distribution and disposition of the rock waste.

Mining men in general appreciate the zones of change between the oxidized outcrops and the so-called permanent sulphides of an ore vein; but few consider the fact that this same rusting alteration also goes on in the country rock in general as well as in the orebodies.[1]

[1]For the rusted, altered, decomposed and oxidized portion of the world's surface, the very appropriate name of "regolith" has been given by G. P. Merrill.

Now, one of the differences between the surface features of the humid and arid regions is the fact that in the former the rocks are rotted and oxidized to great depths, as seen in the various red and sub-soils of the Appalachian region, the Isthmus of Panama, the Great Antilles and other places, while in the arid regions, on the other hand, the depth of surface oxidation, decomposition and rusting are almost nil.

The deep soils and sub-soils of the humid regions are the result of the sub-surface decay and rotting of the rocks, while the so-called soils of the arid regions, the desert sands, adobe, river silts, etc., are usually clean, undecomposed rock, sand and powder, produced by attrition rather than by aqueous rusting and decomposition. They are not disintegrated by rusting but by mechanical processes.

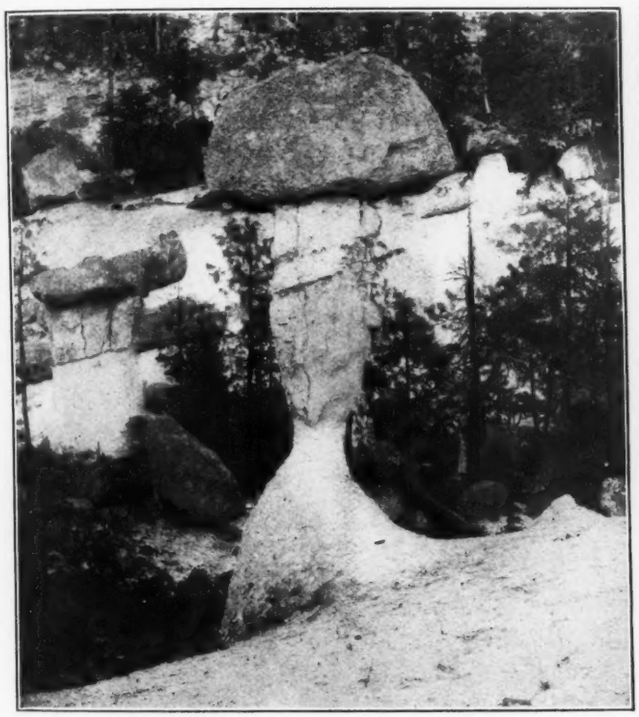
The Great Climatic Factor

The chief factors producing these peculiar surface aspects of the plateau, so different from those of the humid East, as well as in the destruction of the arid plateau are climatic. In the United States, east of the Mississippi river, the precipitation and the evaporation are about equal, 40 in. per year; on the Rocky mountain plateau the precipitation is about 20 in. and the evaporation 60 in.; and in the Southwestern States the precipitation is only 10 in. and the evaporation 80 inches.

Throughout the plateau, except in the portions occupied by the island-like areas of forested humid highland, the sculpturing of the landscape, topography and the surface formations are due to a scarcity of rainfall rather than an abundance, and are the product of change of temperature, wind work and evaporation, processes which are the antithesis of those found in humid regions where water is the great factor. Temperature does the coarse crushing, gravity and storm water the sorting and pulverizing and sliming, and wind the evaporating and transportation. These processes play the most important part in producing the unique aspects of the arid landscapes. Their vast work is but little appreciated by the lay observer, and their effects are ordinarily wrongly attributed to aqueous erosion.

In humid regions where most of our geologic concepts have been formed, the chief disintegrating and transportative agent is water, resulting from an abundance of precipitation and run-off. In the arid regions water plays only a secondary part while ice, which is such an agent in northern regions has performed no work at all. Nine-tenths of the desert phenomena, which the passing observer attributes to water or ice, especially the imaginary lakes and glacial deposits, are the work of temperature, wind and gravity.

The chief function of water there is to redistribute feebly and locally the shattered products of temperature, to grind, pulverize and slime, to spread tailings over the desert and to dissolve and redeposit soluble minerals. Thus it will be seen that the primary factors of destruction and transportation—coarse crushing



WIND WORK, WESTERN SIERRA MADRE

NORTH CHISOS PEAK, TALUS PILE ON RIGHT 500 FEET HIGH

and removal—are the work of the air, while water is only a secondary medium.

Absence of Run-Off

The arid region may be defined as one in which precipitation is not sufficient to produce run-off to the sea, and in the plateau province evaporation exceeds precipitation from three- to eight-fold. It can be truly said that there is not one square mile in a thousand, between the 20th and 35th parallels, from which the rain that falls upon it ever runs off to the sea. This area practically embraces all the vast region between the Colorado Rockies and the volcanic highlands in the altitude of Mexico City. Thousands of square miles in New Mexico, Arizona, eastern California, Nevada and the desert areas of Mexico have no run-off or drainage to the sea whatsoever.

Four great canal-like rivers, derived from the high islands of mountain-tops, run through this vast area embracing thousands of square miles of territory, yet they receive no tributary drainage from it with the exception of the Gila and Conchos. The waters of only three indigenous rivers, with small catchment areas, run constantly to the sea—the Conchos, the Gila and the Sonora. Although it is true that this vast area is abundantly supplied with water works, arroyos, cañons, lagoons, none of the water with its silt and land débris reaches the sea.

Lost Rivers

The streams of the "lost river" type are those which start out with a valiant copiousness upon the timbered highlands and end ignominiously by drying upon the lower desert plains or emptying into shallow lagoons. Yet throughout this vast area, where there is no run-off to carry the débris to the sea, nature has been most extravagant in sculpture of the surface and the waste has been largely disposed of. Great mountains have worn away and vast valleys have been carved out. Huge cañons and arroyos attest the removal of material. Everywhere the great lowering of surface is visible. In view of these facts, the constant question arises: With what tools is this great carving done, and how does nature dispose of the waste and tailings of this work without proper sluiceways?

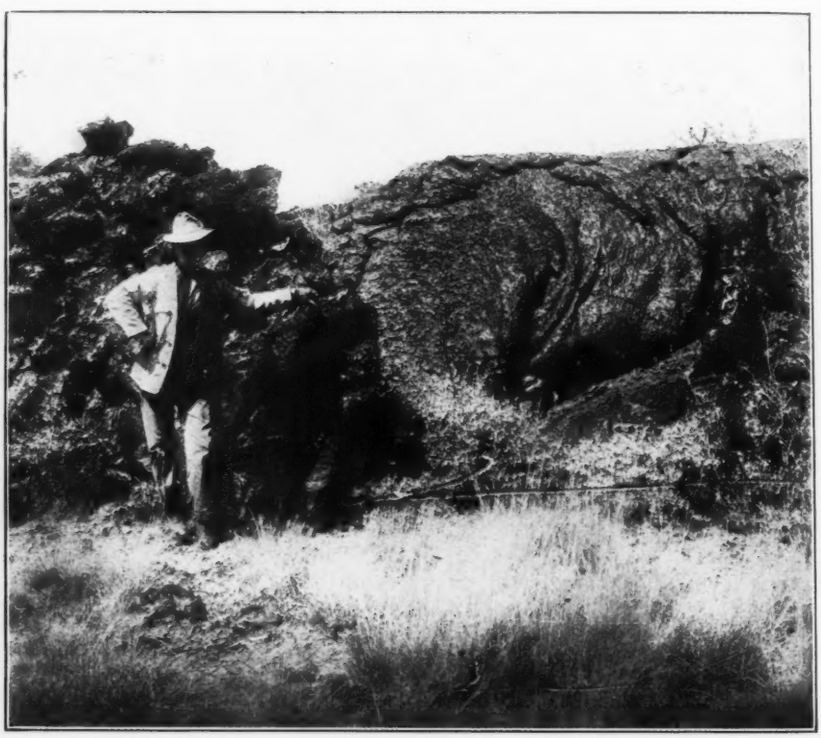
The Cordilleran peneplain when it stood nearer sea level was once a region of abundant streams and run-off, but many or most of the streams of the lost river type have destroyed their own seaward continuations and obliterated them with waste, as the plateau edges constantly recede, and as the streams cut their cañons backward into the plateau. By this process the area of the desert in the lower altitudes of higher evaporation is ever extending. Lost streams of this character, rising and flowing on the higher wooded summits and dying out at the lower plains, are what I have recently termed "suicidal rivers;" for they are constantly shortening and destroying their own courses by destructive erosion of the edges of the natal plateau, while many of the long, dry, narrow waste-filled deserts are now the survivals of what were once cañoned flowing streams.

Processes of Destruction

The greatest thing in Mexico, when one learns to see it, is to observe the operations of the vast processes of destruction, changes of temperature and wind, and the appreciation of their tremendous work. Nature in this region is deliberately crushing, grinding, sizing, washing and fanning the rock material with exactly the same results and the steps of a great quartz mill whose ultimate tailings, drying on the dump, are being blown away by the wind. I hold that with no other conditions than an original high altitude of relief, the present physiography of the arid region can be chiefly accounted for by the destructive work of temperature, gravity and wind. As a result of the climatic processes the material is always dry and non-cohesive. No fine particles can survive upon the eminences, and that which settles upon the plains is being constantly taken up by air in motion and transported to distant regions.

The process of degrading mountains, filling up valleys with the ground-down material and blowing away is ever going on simultaneously, and the sum of the whole process is destruction of the older, higher peneplain of the plateau down to lower and lower levels.

BILL WILLIAM'S MONUMENT, ARIZONA



EDGE OF LAVA FLOW IN THE DESERT

Crushing By Change of Temperature

The daily range of the thermometer in this region, from hot afternoon to cold early morning, is often more than 80 deg.,

and in Sahara and Central Asia the range is even greater. This variation of temperature from 130 deg. F. at midday to 50 deg. at night results in contraction and expansion, and it fractures and shatters the solid rock outcrops into millions of fragments. Massive limestones and some of the rhyolites and other solid volcanic rocks are shattered into angular breccia, granular sandstones into sands and shales into dust. In some cases the rocks are caused to crack or peel off in skins.

Dr. Livingston noted in Africa that surfaces of rock which were heated up to 137 deg. during the day, at night cooled so rapidly by the radiation that they threw off sharp angular fragments, from a few ounces to a hundred pounds in weight. Von Streeruwitz has noted that in the Quitman mountains of Texas the bare rocks split with loud reports. By this continuous operation, cliffs are disintegrated and the surface of arid plains loosened. The surface of every rhyolitic and granite peak, every limestone ledge, every sandstone cliff and every shale bank, is being strained, stretched and broken by this great natural crusher agent. This process goes on constantly.

The quantity of shattered rock material thus produced is beyond expression. Everywhere the intelligent observer may see rock fragments lying upon the surface and at the foot of cliffs, which have been broken by this agency and prepared for gravity transport until ground into desert dust.

Gravity

Rocks seek their level as well as water; and in the arid regions vast quantities of rock find lower levels without the aid of water. A great factor in rock grinding, distribution and sizing is the force of gravity. In almost any locality one may observe the process of rock material slipping and sliding down slopes. Innumerable instances can be seen of rocky peaks and ledges accompanied by vast talus slides leading down from their cliff lines toward the plain. This is especially true of peaks of hard limestone and igneous rocks. The material, shattered by the cooling temperature of night, rolls and slides in vast quantities, and is still further broken and sized by this process. Such of this material as is pulverized sufficiently fine is taken up by the winds. The remainder gradually works its way toward the foot as great natural dump piles of talus. In the cliffs of *mesas, arroyos* or gulches, composed of softer material, such as Cretaceous shales, or of desert sands and adobes, one can frequently see regular streams of the soft, dry particles flowing down in coulees and creating small delta, fan-like piles, below.

DESERT PROCESSES OF EROSION WEARING AWAY THE THOUSAND-FOOT LIMESTONE CLIFF, GUADALUPE PEAK, TEXAS

Work of the Lost Rivers and Arroyos

It is very evident that the function of the lost rivers is not to transport the waste to the sea but to grind rock waste into silt which it spreads out as slimes in temporary settling tanks, lower streamways and temporary lakes known as *lagunas*, to be ultimately dried and largely blown away by the winds. Like water in a pan, they serve only to redistribute locally the material fractured by variations of temperature and to grind it into finer rock powder, ready to be dried and transported by the wind.

The cloud-burst torrents, which at times fill the arroyos, are also only a wet process of grinding, sizing and sliming rock waste. The shattered material is washed into these torrential sluices of steep gradients and further crushed and sized. The finest tailings reach the desert plains, while coarser sizes are deposited as talus deltas at the foot of the steep cañon slopes.

Work of the Wind

Air is the great corroding and transporting agent of the plateau deserts. It does the double work of disintegrating rocks superficially, and, when in motion, of distributing and transporting the material after it has been pulverized into dust by temperature, gravity and water. Flowing up and down the cañons, blowing over the dusty plains, sweeping the faces and ledges of the cliffs, the winds pick up and transport rock powder wherever found, blowing it hither and thither to new lodgments, or taking it in great swirls and whirlwinds to higher atmosphere to be carried hundreds of miles away. The work of the wind is always a striking feature to the observer. I have often counted as many as 20 visible whirlwinds at a time, each laden with dust and sand and each performing the work of rock transportation.

Transportation, however, is not the only work of the wind. It, too, etches, caves, undermines and otherwise helps in the great desert work of converting solid rock into rock powder. The high winds undermine the softer material between ledges, causing the latter to fall and crumble by their own weight. Familiar instances of this may be seen wherever bluffs of stratified rocks are exposed. Sand grains in rapid motion are effective

cutting agents. This is well illustrated by the sand blast. Familiar examples of sand erosion are the grinding of the surface of lighthouse lenses, and the cutting and polishing of Egyptian monuments. By this erosion the desert pebbles are ground into facets with sharp edges. The surface of rock outcrops are etched into rectangles and other forms, and in many cases give a peculiar and characteristic appearance known as desert polish.

Many of the large erratic blocks of sandstone, limestone, granite or rhyolite, which are seen standing on apparently narrow pedestals in the West, owe their appearance to the undermining action at their bases of drifting sand.

Hollows on rock surfaces (aerial pot holes) are also made by grains of sand or similar pebbles kept in gyration by the wind, eroding the shallow cavities in which they lie. On a larger scale in the adobe deserts this action results in the scooping out of broad, shallow basins which, when rain comes, are turned into lagoons.

Much of the so-called bad-land sculpture attributed to water work is really due to wind and gravity. Even the great chasm of the Colorado owes much of its size so far as width is concerned to these agencies. In the vast arid plateau drained by the Colorado river, so great has been the wind denudation that thousands of feet of horizontal strata have been removed from the surface, as is attested by the remaining cliffs and buttes. The surface dust of the great Chihuahuan and Sonoran deserts is in almost constant motion by the wind.

The wind-blown débris is constantly being shifted, ground and sorted over and over, but its ultimate destiny is escape from the region of its birth. Some of the dirt settles over the desert levels in thin layers. Often it is assisted in locating by vegetation, and, in many instances, as in the *medanos* of northern Chihuahua it is collected into sand hills which travel back and forth over the country. A considerable amount of the fine dust reaches the flowing rivers, but this is trivial in comparison to that which is outwardly carried away from the land.

The finality of the protracted wind action is to carry the material entirely away and thereby it is continuously lowering the general level of the land, transporting away from the region in the form of dust clouds, vast quantities of the rock waste of the original country, just as rivers in humid regions transport similar waste to the sea. Thus it is that vast quantities of the finer dust of the Cordilleran region are blown away by the wind into other regions and to the sea, and that most of the great quantities of material of denudation are disposed of.

Sufficient data does not exist to give quantitative measurement of how much of the general lowering of the plateau region has been due to the wind and how much to water. We have, however, two elements of the problem in the fact that while 30,000 ft. of stripping are known to have taken place from portions of the plateau, the thickness of sea-deposited sediments derived from this area during the time of this denudation on either the Pacific or Atlantic coast does not exceed 5000 ft. Without more definite data concerning the relative sizes of the areas of denudation and deposition no definite conclusion can be stated, but assuming that they are practically similar it would then appear that the proportion of wind to water denudation has been six to one.

It may seem a queer thought to propound, but our story may be summarized in the statement that the plateau is literally being lowered by blowing away. In any event there is little doubt that millions of tons of rock powder are annually taken away from the surface of the plateau by the wind and much of this is ultimately carried out to sea to settle to the ocean's floor. During the recent eruptions of Pelée in authenticated instances the volcanic ash fell on decks of vessels 800 miles distant.

A New Discovery of Bauxite in Georgia*

By Otto Veatch†

A discovery of bauxite has recently been made in Central Georgia. The occurrence has not yet been thoroughly prospected and it is too early to make any predictions as to its future commercial importance, although the outcrops of the mineral present a very favorable prospect.

The deposit is situated three miles east of McIntyre, Wilkinson county, and about 1½ miles north of the Central of Georgia Railway. The deposit is in no way connected with those of northwest Georgia, either geographically or geologically, being located about 150 miles distant, and in the Coastal plain. It lies near the northern margin of the Coastal plain and occurs in strata of probably lower Cretaceous age, the Tuscaloosa formation. It is overlaid directly by red sands and impure clays of Eocene age. The strata in this vicinity are for the most part unconsolidated sands and clays, having no pronounced structural features; the beds lie almost horizontal, having only a slight dip southward.

The bauxite occurs in blanket form, its lateral extent greatly exceeding its thickness. The position of the bed can be traced by small fragments at the surface for a distance of about ½ mile, and it maintains a rather uniform level. It lies near the contact of the red argillaceous Eocene sands and a bed of white and stained massive clay. I offer the opinion, tentatively, that the bauxite is an alteration product of the bed of white clay, or kaolin, and has resulted from desilication of the kaolin.

The mineral is pisolitic and varies in color from bright red to yellow and cream color. The pisolites are generally quite small, the majority varying from 1/10 to ½ in. in diameter; they may either make up the entire mineral, or may be scattered in an amorphous matrix. The bauxite is hard at the surface, although it will doubtless be found much softer where not exposed to atmospheric action.

The writer collected three samples of the pisolitic mineral from the outcrops. These were analyzed by Dr. Edgar Everhart, chemist for the Geological Survey of Georgia, with the following results:

	I. Per Cent.	II. Per Cent.	III. Per Cent.
Al_2O_3	57.58	52.92	55.21
SiO_2	9.38	10.17	12.40
Fe_2O_3	.96	7.66	.96
TiO_2	2.76	2.30	2.15
H_2O (combined)	29.12	26.55	29.10
Moisture	.35	.35	.33
Total	100.15	99.95	100.15

The second analysis represents the most ferruginous of the samples, which was a bright red in color. The clay underlying the bauxite approaches a kaolin in composition, except that it is in places highly stained with iron oxide.

The lateral extent of the deposit has not yet been determined, and the total amount of the bauxite cannot yet be estimated. However, it is known to reach a thickness of 10 ft., and from the outcrops and a small amount of prospecting, 100,000 long tons are known to occur at the point of discovery; this amount will certainly be increased by further prospecting. The overburden consists of unconsolidated sand and will vary from a few feet, with a gradual increase, to 40 ft., provided that the bed is extensive laterally. The mining of the ore would present no special difficulties, and water for power and other purposes is abundant.

*Published by permission of the State geologist of Georgia.

†Assistant State geologist, Atlanta, Ga.

Two Old California Mines

Special Correspondence

Two of the oldest gold mines in California can show records of work for half a century or more. Both are in El Dorado county, and both are in the camp of Georgia Slide, well known for its "seam diggings." One of these is the Beattie mine which is just closing its 54th year of continuous operation with a full working force opening ground for stoping; and the other is the Pacific, which has been worked steadily for 50 years, and is still making a good annual output.

Stories of the Batopilas Mines, Chihuahua

Practice at Governor Shepherd's Uncertain but Rich Properties When Reports of "No Ore in Sight" Alternated with "Not Enough Rock to Blast"

BY MARK R. LAMB*

Much has been written of late on the subject of mine sampling. There are several methods considered standard, but also there are several mines which do not fit these standard methods.

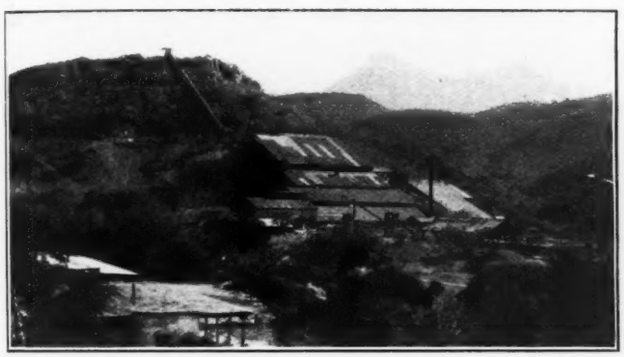
Not many years ago the Batopilas mines in southwestern Chihuahua were under option for sale, and were examined and sampled carefully. The story told is that Governor Shepherd, who was in charge of the property from the organization of the company until the time of his death, watched the sampling for some time in silence.

"Why are you taking all these samples of barren vein stuff?" asked the Governor. "I can tell you now that there is nothing in that rock."

"But we are sampling only what we consider to be vein matter," said the engineer. "What we want to know, of course, is how much ore you have in sight."

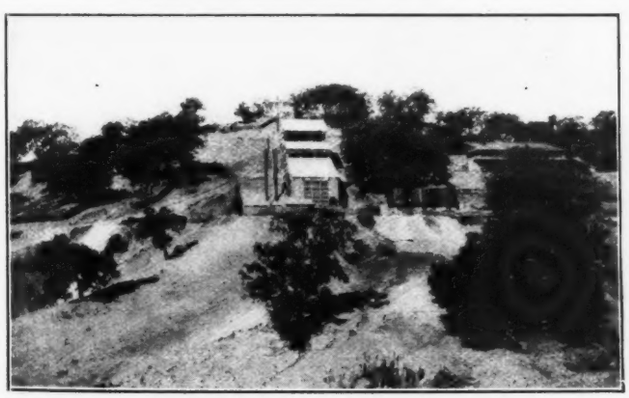
"Well, I see my finish," said the Governor. "We have *no* ore in sight. Just as soon as it gets in sight we take it out of sight."

The sampling proceeded along these lines, however, much to his disgust, and it is said in Batopilas that the engineer reported the mine to have ore in sight worth about one-tenth the price asked for the mine. Nevertheless, in the short time between the examination and the publication of the engineer's report, the mine production was more than was reported in sight by the engineer.



SIXTY-STAMP MILL AND CYANIDE PLANT AT CHINIPAS

RIO FUERTE



THE MILL AT GUERRERA AL TERANO (WAR TO THE TYRANT) MINE

A SIX-STAMP WATER POWER MILL

The mine is in an almost chronic state of being out of ore, but when it is in ore, straight silver is mined. This peculiarity has given rise to practices found nowhere else. It is the custom to telephone to the mine each day for information as to the number of mules required to transport the day's output to the *hacienda*. Sometimes only two are required. Sometimes 30 are not enough. The shipment from the mines for one day has at times closely approached $100,000.

An Unexpected Bonanza

At one time, it is said, the Governor was in New York and unexpectedly drew on the mine for $90,000. He advised them of this by telegraph which gave the officers at the mine several days' grace. The exchequer was low and no ore was "in sight." Days passed with no pockets of silver appearing and the report from the mine at 1 p. m. of the last day said, "Three mules will be more than enough." The staff was in despair and the Governor's name was handled without gloves. But at 6 p. m. the mine superintendent telephoned excitedly, "How many mules can you send me?"

"Your three mules must be nearly there by this time," replied the office man.

"Yes, but how many more can you send?" and there was a tremble in his voice.

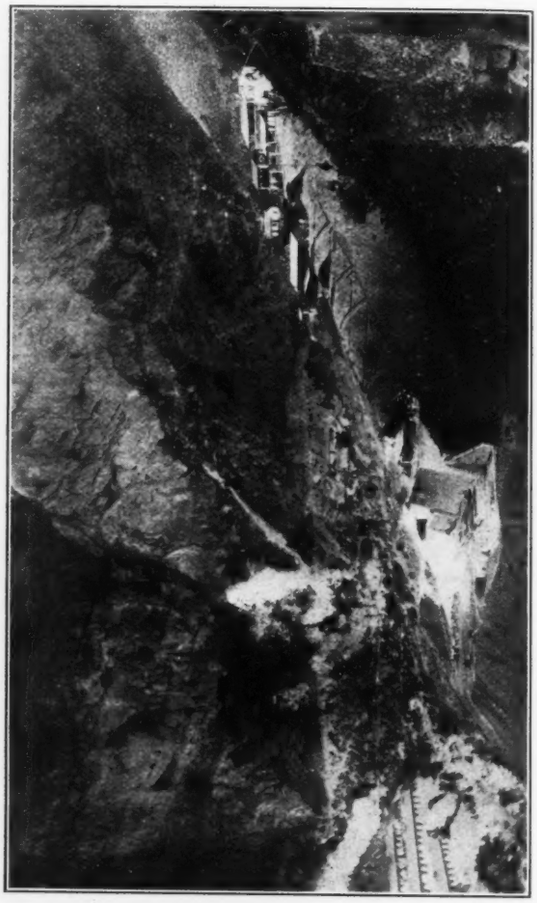
"Have you struck anything? How many animals do you want?" asked the office.

"It looks now like about 30 loads, but we are not through it yet. It's going to be hell to get it out; it will not shoot; not enough rock. Send a crew from the shops with cold-cutters!"

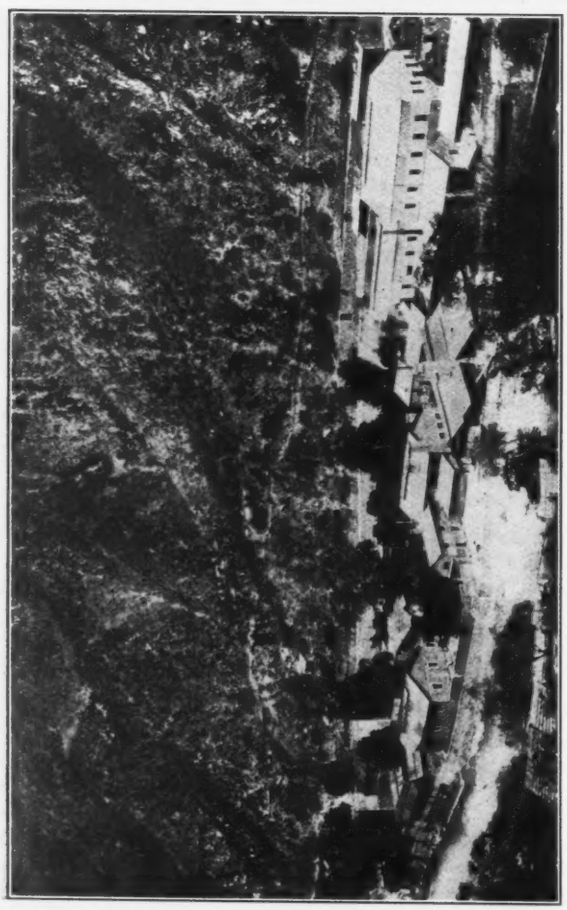
This ore was "in sight" less than 48

*Mining engineer and metallurgist, Guanajuato, Mexico.

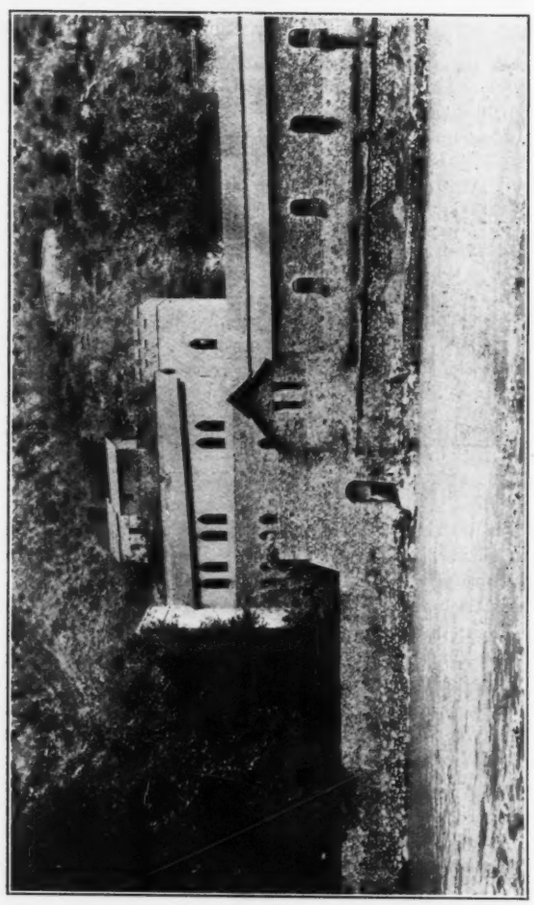
TOWN OF BATOPILAS



GRADING FOR 150-TON MILL AT LLUVIA DE ORO



"THE HACIENDA" AT BATOPILAS



BATOPILAS RIVER AND MANAGER'S RESIDENCE

hours, but the draft was covered. About the only way to sample such a mine is to examine the books, but what engineer would recommend the purchase of a mine merely on its record?

Metallurgy to Fit the Conditions

I had heard that this company discharged tailings worth $10 per ton into the river and as 120 stamps were in operation the prospects for a cyanide plant were bright. There *is* one waste product worth $10 per ton, but only about one ton per day is discharged.

The process as a whole is not duplicated anywhere else, so far as I know. To begin with, run-of-mine stuff is very low grade and consists of the sorted vein stuff together with the rock mined incidentally while searching for pockets. All this is sent to the 100-stamp water-power mill for concentration. It varies in value, seldom containing more than 10 oz. silver per ton. That portion of the high-grade ore which cannot be melted directly in the *vaso* goes to a light 20-stamp mill, and it is a sight to see the stone that is fed to this mill. Much of it is half silver-wire, plate and crystal of most beautiful form. With the battery screen off, the mortar appears to be full of babbitt metal. Most of the silver remains in the mortar and the pulp passing the screen goes over plates to amalgamating pans. The tailings from the pans carry about 100 oz. per ton. These tailings, after drying, are charged, after mixing with the 100-stamp-mill concentrates, into reverberatory furnaces preparatory to lixiviation. The fuel cost is high but the quantity treated is small and the extraction excellent. As the head assay of the ore for the big mill has at times been as low as 2 oz. per ton, it can easily be believed that the tailings offer no attraction to the cyanider.

Ten Days From Railway

This camp is much like Pinos Altos in the northern part of the State, where the mine is the sole support of the town and neighborhood. This puts the manager in the position of a sort of father to all. The people call Alex. Shepherd, the present manager, by his given name and it is doubtful if there is a person in the region whom he does not know personally. The American colony in Batopilas is a delightfully hospitable and happy lot. The fact that Southerners predominate probably accounts for this. It is said that in the Governor's time rigid social eitquette was enforced even with visitors. It must at times have been disconcerting to the new arrival to be required to find a dress suit for dinner. The trip to the mines was only a matter of 10 days' hard riding on a mule, over a route called a trail by courtesy. Since Stillwell's railroad has reached Aguatos a new trail has been cut which can be covered in three days. Engineer Brodie had no small task in making the new trail, and among other things, was obliged to build a long suspension bridge over the Urique river. Transporting the material on mules required much ingenuity in designing and planning.

In the early days the Governor was partial to American labor and no wanderer need apply twice had he any skill whatever. Alex. Shepherd, however, is obtaining full value for all expenditures for labor account, and on account of his great experience with Mexicans, has an excellent and efficient staff of less expensive men. The mine is conducted as a business proposition strictly and is paying dividends.

My trip was made during June, supposed to be the most difficult for traveling, but as it was a choice between traveling in June and being wet, or waiting until after the rains and being obliged to endure the heat, the former was the less of the two evils. Just as we came in sight of the town of Batopilas, looking down from the divide from a hight of perhaps 6000 ft., we were obliged to seek shelter from a sudden, terrific hail storm. After this passed we wound slowly down the trail and in three hours were in town. The temperature was exactly 104 deg. in the shade! With no expectations of relief, the iced refreshments provided at the *hacienda,* the first after several weeks of travel from camp to camp, horseback, fully repaid all the privations of the trip.

Giroux Consolidated Mines Company

In the report of this company for 1907 E. W. Walter, the general manager, describes the development of the mines. He states that the block of milling ore developed by the workings from the Morris, Brooks and Bunker Hill shafts is 2000 ft. long, 160 ft. thick, and 150 ft. wide, with ore still showing in most of the crosscuts. As it stands it contains approximately 4,000,000 tons of ore, with an average copper content of not less than 2.25 per cent. and 20c. gold per ton. A large proportion of this orebody will average better than 3 per cent. copper. In the workings from the Giroux, Taylor and Alpha shafts there is blocked out about 350,000 tons of smelting ore, averaging 6.5 per cent. copper. A shipment of 200 tons in September showed from 12 to 13 per cent. copper, 14 to 17½ per cent. iron, 3 to 6 per cent. sulphur, and 44 to 52 per cent. insoluble matter. The Alpha shaft is now sunk to a depth of 1100 ft. Ore was first encountered at the 1000-ft. level, the ore in the vein above that point being completely leached out. At 1100 ft. the vein is still oxidized, but it is expected that sulphides will be encountered at 100 to 200 ft. greater depth.

A test run of the concentrating mill was made in October, which showed that a high percentage of mineral can be recovered from the milling ore. With respect to the water problem, it is expected that at least 80 per cent. of the water used in milling can be recovered for further use. It is the intention of the company to bring in water from Steptoe valley. In the meanwhile it is expected to obtain a sufficient quantity from the Alpha shaft. "The estimates of the management in respect to the water supply from the shaft have been fully realized. The flow in the Alpha shaft has increased rapidly with depth within the first 100 ft. sunk below the 1000-ft. level. Sufficient water is now available to run the mill at half its capacity, while further developments in the Alpha will admit of increased operation."

A report on the water problem was made by Alexander Potter, consulting civil engineer, of New York, under date of Jan. 24. He is of the opinion that an adequate supply can be obtained from the north fork of Cleveland creek, in Steptoe valley, and recommends the installation of a plant for pumping 1,500,000 gal. per day to the mines. This will have to be pumped against a total static and frictional head of 1105 ft. Mr. Potter estimates that a 12-in. pipe line will cost $188,694, including 15,400 ft. of heavy line pipe at $3.05 per ft., and 35,600 ft. of line pipe at $2.20 per ft. The estimated cost of the pumping station is approximately $40,000. The annual average operating cost is estimated at $35,000 based upon coal at $10 per ton, engineers at $6 per day, and firemen at $4 per day.

Mr. Potter states that the amount of water needed at the mines when running at their full capacity is 300,000 gal. in addition to that which can be secured from the Alpha and Giroux shafts. Charging the mines for the water at the same rate per 1000 gal. as would be charged to consumers, the daily cost to supply the mine with water will be $75. This amount of water is sufficient for milling 750 tons of ore, but the available supply and the pipe line to be installed are adequate for 2500 to 3000 tons of ore. At $75 per day for 750 tons of ore, the cost of water will be 10c. per ton, which Mr. Potter estimates to be cheaper than to carry the ore to Steptoe valley for milling. At Cananea, Sonora, the water supply is obtained under conditions similar to those which exist at Kimberly. In each case approximately 1000 gal. per minute has to be pumped. At Kimberly the difference in elevation is 967 ft.; at Cananea it is 900 ft. At Cananea the water is pumped through an 8-in. line. In using a 12-in. line at Kimberly, the total head, including friction, will be 450 lb. per sq.in., equivalent to a head of 1100 ft., whereas at Cananea they pump against a head of 750 lb. per sq.in., equivalent to a head of 1815 ft.

America is the chief market for diamonds.

Map of Southwestern Chihuahua, Mexico

By H. A. Horsfall.*

The map of southwestern Chihuahua, reproduced on another page, was compiled from notes of triangulation surveys which I made in the years 1884 to 1889. These surveys are the official surveys of the state and the original copies are on file at the office of the Minister of the Interior, in the City of Mexico. They were made under a concession from the Mexican Government given to the Compañia Deslindadora de Baldios del Estado de Chihuahua, of which the late Ex-Governor Celso Gonzalez was the head, and the late Jose Valenzuel was chief engineer. The company was authorized to determine the amount of vacant land in the state, and in consideration of the payment of the entire cost of the survey, they received title to one third of all the vacant land found. The portion shown on the map contains about one third of the total area of the state of Chihuahua. The state was formerly divided into *cantons* or counties, of which there were 21; at present it is divided into districts, which include several of the original counties.

The surveys of each county were made separately by the several engineers connected with the work, each one of whom reduced his work to conform to a separate meridian. For this reason and also on account of the indeterminate location of the division lines between the various counties, the separate maps, when directly plotted were found to overlap. In the present compilation, additional and later surveys made by myself and notes obtained from various sources have been incorporated. I continued to reside in the section of country under consideration until the year 1898. The engineers who were engaged on the original surveys, in addition to myself, were, Alfred Hampton, A. Q. Wingo, Wm. J. Glenn, Lieut. Henry O. Flipper, Thos. F. Doyle, and Wm. R. Morrison. These engineers kindly furnished me copies of their maps and notes, and to them thanks are here extended.

Topography of the District

The general topography of the country, presuming a line running through the City of Chihuahua and parallel to the west coast, having a general northwest and southeast direction is as follows: West of this line, the land consists of gently rising plains, interspersed with low mountain ranges with wide valleys between. The elevation at Chihuahua is about 4700 ft. The continental divide is found on a line parallel with the line mentioned, and slightly to the west of the Laguna of San Bernabee. The altitude is about 7500 ft. From this line west for 40 or 50 miles on the Pacific slope the country is slightly more broken and the valleys narrower. The altitude is about 7000 ft. Continuing to the west and taking a strip of country about 80 miles wide and extending to and parallel with the southwestern border of the state of Chihuahua, the surface is very broken, the space between the streams forming mesas or table-lands having an approximate elevation of about 7500 ft.

The main streams flow far below in narrow valleys, in many cases forming impassable box cañons. There are no very high mountains, the highest peak in the state of Chihuahua being that called Muinora (elevation 11,500 ft.), situated in the extreme southern part of the state, south of the mining town of Guadalupe-y-Calvo. Other prominent peaks are San Miguel (7500 ft.), Santa Barbara (8300 ft.), and San Ygnacio (8100 ft.).

The mesas or table-lands in some parts extend to the extreme western border of the state and are in the most part covered with a fine growth of pine and oak timber; but owing to the rapid fall of the streams and the absence of roads, the forests are not available for lumber except locally.

The climate is temperate at the higher elevations. Below an elevation of about 5000 ft., the timber and vegetation is of tropical growth, and the temperature is torrid.

West of the dividing line between Chihuahua and the states of Sonora and Sinaloa, the mountain slope is very abrupt, falling 4000 to 5000 ft. within a very few miles to low foothills, whence the country descends gradually until it reaches the Pacific ocean, the distance being from 80 to 90 miles.

*Mining engineer, New York.

Urique District, Chihuahua, Mexico

Special Correspondence

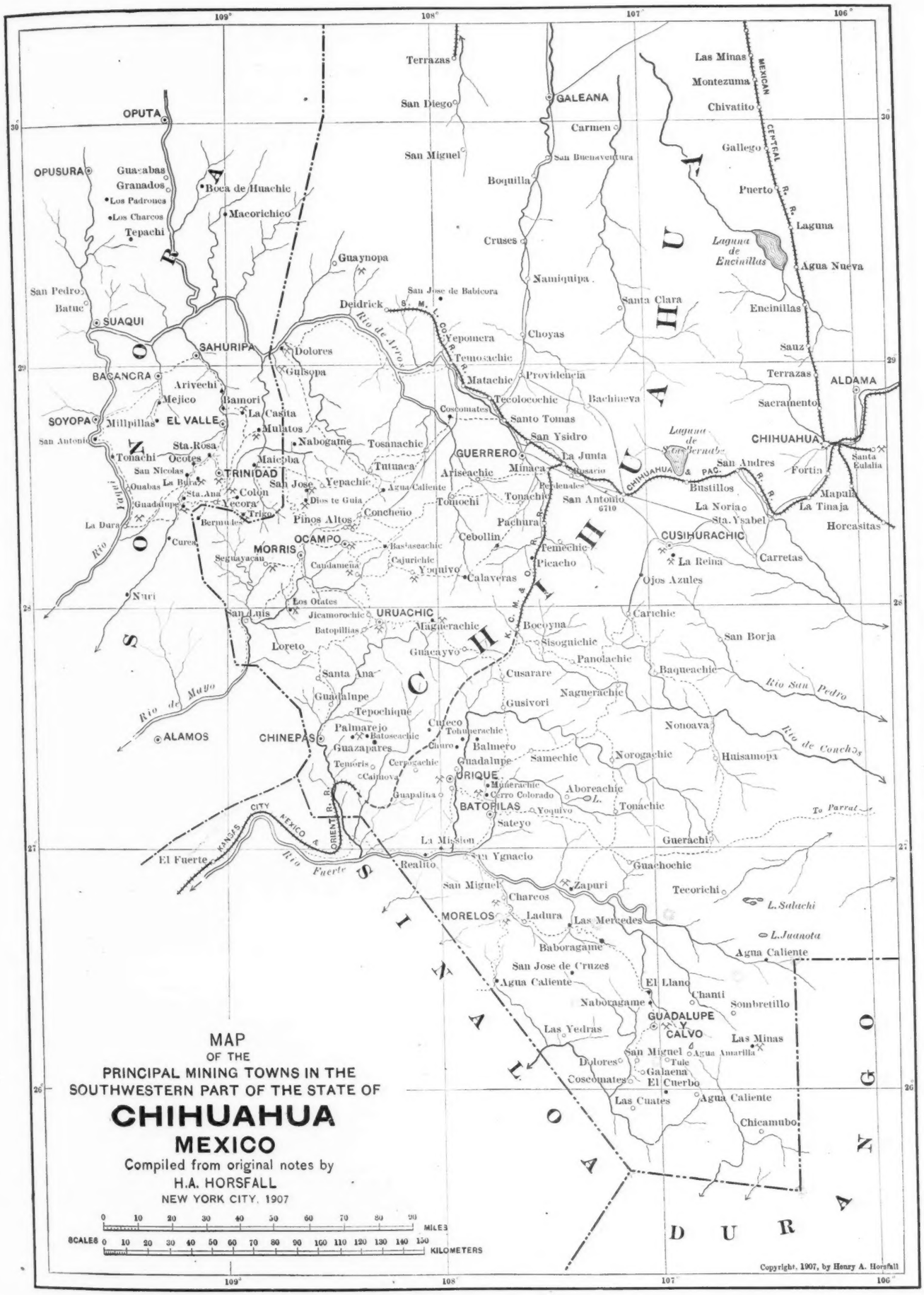
In the western part of the state of Chihuahua, near that part of the boundary line where the states of Sonora and Sinaloa come together, in the section of the Sierra Madre just south of what is known as the Jesus Maria, lies a rough country frequently spoken of as "the corner." It was made famous by the old properties of Batopilas, Guazapares and Chinipas, and the more recent rich finds of the Lluvia de Oro and the Calabacillos. In the center of this rich section of country is the little settlement of Urique, of rather unknown age, and located at the lower end of a great gorge known as the Barranca del Cobre, which has a depth of from 4000 to 5000 ft. Capped as this country frequently is with a lava flow, the underlying formation is made up principally of slates and sandstones, cut by great porphyry dikes (andesite and rhyolite) and their accompanying fissures, in which, more than along the planes of contact, occur the deposits of silver, with usually some copper and lead, and frequently rich in gold.

At present Urique is three days' ride on mule-back from Sanchez, the present western terminus of the Kansas City, Mexico & Orient railroad, 190 miles west from the city of Chihuahua, but the Orient road now leaves a gap of little more than 150 miles between Sanchez and its extension from the Pacific coast port of Topolobampo and has done much to mitigate the difficulties of travel. By the end of another year the Orient should have made its connection, and then Urique will be only a few hours from the railroad.

American capital is seeking promising properties in this section, while they may yet be had for a reasonable figure, and that they may be developed and ready to ship by the time of the completion of the railroad. For a little more than a year now the Mexican Metallurgical Company has been operating in this district, at Bagueriachic, the Piedras Verdes mines, held under lease and bond from Buenaventura Becerra, who was one of the original owners of the Lluvia de Oro and sold this mine to the present owners for $2,000,000 gold.

Another new and important company near Urique is the Rosario Mining and Smelting Company of New York, which by purchase and denouncement has acquired about 100 pertinencias (250 acres) and is preparing for active development work. The ores of these properties are largely of chalcopyrite carrying silver and gold. Among the plans of the Rosario company are a large concentrating mill and a reverberatory matting furnace. The president of the Rosario company is C. R. Peterkin, of New York, and the resident manager is G. B. Jacobs. Closely allied to this company is the Pilon Mining and Milling Company, controlling an immense out-cropping ledge of gold ore, on which, however, little work has been done as yet; the Urique Development Company whose plans are to enter into a general prospecting and development business, and the Arosco Mining Company of Philadelphia, which has taken up for development some very promising prospects near Urique.

Metallographic methods, applied to the study of non-ferrous metals, have shown that varying structure results in copper, brass and bronze from varying degrees of heat in melting and pouring as well as from forging, rolling and other mechanical processes.

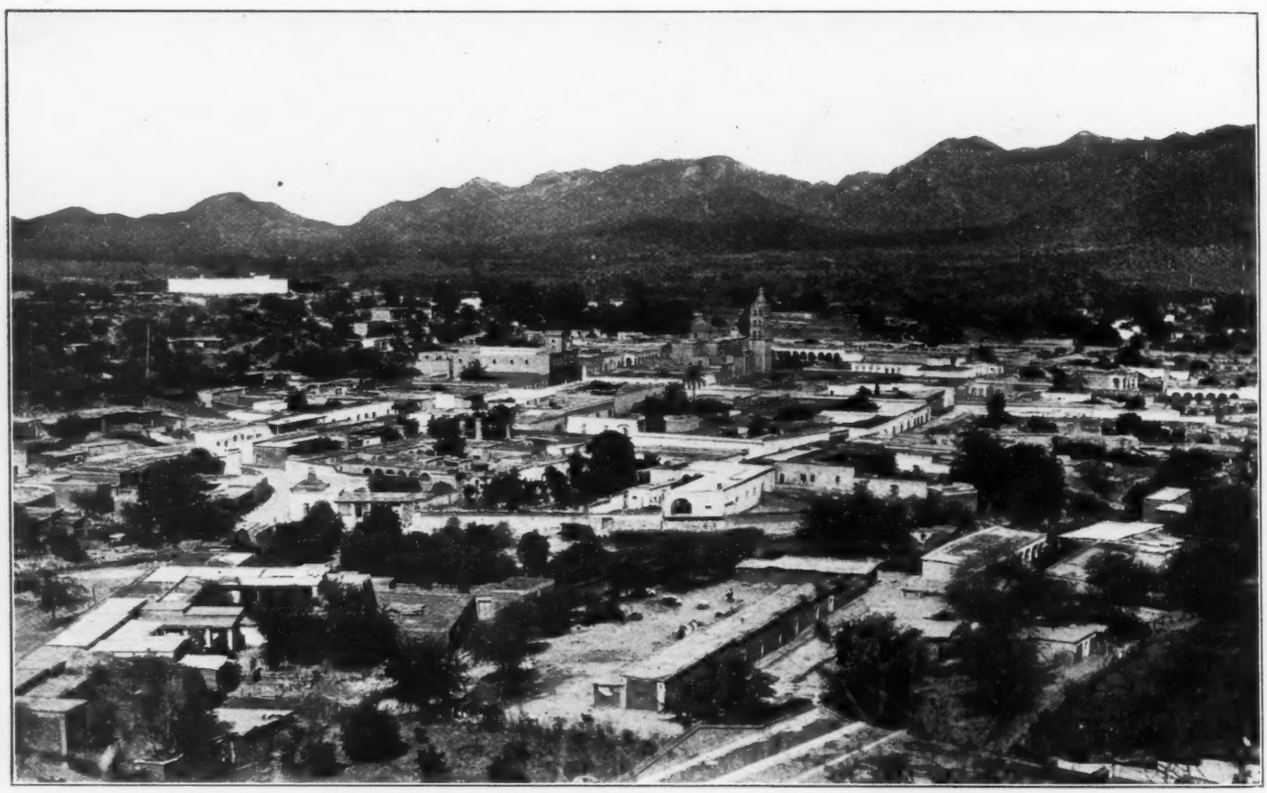

MAP
OF THE
PRINCIPAL MINING TOWNS IN THE
SOUTHWESTERN PART OF THE STATE OF
CHIHUAHUA
MEXICO
Compiled from original notes by
H.A. HORSFALL
NEW YORK CITY. 1907
SCALES 0 10 20 30 40 50 60 70 80 90 MILES
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 KILOMETERS
Copyright, 1907, by Henry A. Horsfall
SONORA
CHIHUAHUA
DURANGO
OPUTA
OPUSURA
SUAQUI
SAHURIPA
BACANCRA
SOYOPA
EL VALLE
TRINIDAD
MORRIS
OCAMPO
URUACHIC
CHINEPAS
ALAMOS
URIQUE
BATOPILAS
MORELOS
GUERRERO
GALEANA
ALDAMA
CHIHUAHUA
CUSIHUIRACHIC
GUADALUPE Y CALVO
Terrazas
San Diego
San Miguel
Carmen
Las Minas
Montezuma
Chivatito
Gallego
Puerto
Laguna
Agua Nueva
Encinillas
Sauz
Sacramento
Fortin
Santa Eulalia
Mapula
La Tinaja
Horcasitas
Carretas
Ojos Azules
La Reina
La Noria
Sta. Ysabel
Bustillos
San Andres
Boquilla
Cruses
Namiquipa
Santa Clara
Choyas
Providencia
Bachineva
Tecolocochic
Santo Tomas
San Ysidro
La Junta
Minaca
Ariseachic
Tutuaca
Tosanachic
Nabogame
Maicoba
La Casita
Mulatos
Millpillas
Mejico
Arivechi
Ramori
Dolores
Guilsopa
Deidrick
Guaynopa
Tepachi
Macorichico
Boca de Huachic
Granados
Guacabas
Los Padrones
Los Charcos
San Pedro
Batuc
Yepomera
Temosachic
Matachic
Cosconates
Tonachi
Ocotes
Sta. Rosa
San Nicolas
Onabas
La Bufa
Sta. Ana
Guadalupe
Yecora
Colon
Bermudez
Trigo
La Dura
Cures
Nuri
Los Otates
San Luis
Jicamorochic
Batopillas
Loreto
Santa Ana
Guadalupe
Tepochique
Palmarejo
Batoseachic
Guazapares
Tenoris
Cerocahui
Cajuova
Guapalina
Cureco
Tohuerachic
Churo
Balmero
Guadalupe
Cerocahui
Mineraehic
Cerro Colorado
Yoquivo
Sateyo
La Mission
El Fuerte
Realito
San Miguel
Charcos
Ladura
Las Mercedes
Baboragame
San Jose de Cruzes
Agua Caliente
Naboragame
El Llano
Chanti
Sombretillo
Las Yedras
Dolores
Coscomates
San Miguel
Tule
Agua Amarilla
Galaena
El Cuerbo
Las Cuates
Agua Caliente
Chicamubo
Las Minas
Tecorichi
L. Salachi
L. Juanota
Agua Caliente
Guachochic
Guerachi
To Parral
Aboreachic
Tonachic
Norogachic
Samechic
Huisamopa
Nonoava
Baqueachic
Rio San Pedro
Rio de Conchos
Nagueraehic
Gusivori
Cusarare
Panolachic
Sisoguichic
Bocoyna
Carichic
San Borja
Guachayvo
Magueraehic
Batopillas
Jicamorochic
Los Otates
Rio de Mayo
Rio Fuerte
Rio Yaqui
Rio de Arroyos
Cajurichic
Yoquivo
Calaveras
Pachura
Cebollin
Temechic
Picacho
Concheño
Pinos Altos
Dios te Guia
Agua Caliente
Yepachic
San Jose
Tomochi
Tonachic
San Antonio
Perdenales
Rosario
Mapula
Cascada
Cusihuiriachic
Cusihuiriachic
Cusihuiriachic

Empire Building in Western Mexico

Great Areas of Mineral Lands from Which Millions Have Been Extracted by Ancient Miners Will Be Opened by New Railroads

BY PERCY E. BARBOUR*

Few people realize the enormous possibilties of that part of Mexico which lies west of the Sierra Madre Mountains, extending to the Gulf of California and the Pacific Ocean; and few realize the prodigious amount of work now being done there by American brains and American capital to open up this hitherto almost unknown territory. It requires a trip of days over the now advancing railroads, days and nights spent in rickety, uncomfortable, Mexican *diligencias* and many more days spent in the saddle to appreciate fully what the southern part of the State of Sonora and the northern part of the State of Sinoloa promise. I have just returned from such a trip including nearly one thousand miles in the saddle. The impression produced by the trip leads me to believe that this portion of Mexico will in the next five years make greater strides forward and enjoy more relative prosperity than any other part of the Mexican republic.



VIEW OF ALAMOS, SONORA, MEXICO

Railroads

Up to within a decade ago little was known of the State of Sonora and its only railroad extended from Nogales, Arizona, to Guaymas on the Gulf. This road, then under the control of the Santa Fé system, has since passed to the Southern Pacific; and whether from cause or effect has been growing constantly in importance. The ride of 12 hours from Nogales to Guaymas is indeed an interesting one; it takes the traveler over arid deserts, through groves of oranges and through miles of cactus.

Guaymas is beautifully situated on the bay of Guaymas on the Gulf of California and has the best harbor and is the most important town on the west coast of the republic. It has large stores and supply houses, many wealthy and high-class Mexicans and many Americans.

About five miles north of Guaymas is the new town of Empalme from which point starts the new railroad system which is to open up this new empire of the West. Empalme is also on the bay of Guaymas and it is not unlikely that it will outgrow and outclass the older town unless the latter puts up a struggle. Here are the new railroad terminals and supply headquarters, and here is being built a railroad quay half a mile long to the edge of the channel so that ships can dock to discharge their cargoes, while at Guaymas the old system of lightering freight to and from ships still goes on. If Guaymas had a Yankee board of trade the members would be sitting up nights with an eye on Empalme.

Cananea, Yaqui River & Pacific

This new railroad system now being rushed to completion is the Cananea, Yaqui River & Pacific which is controlled and operated as part of the Southern Pacific System. Beginning at Empalme, the main line runs southerly and easterly through a desert country covered with cactus to Corral, which is the first junction point. This is in the midst of the Yaquí country, and along the railroad are watchtowers where Mexican soldiers

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keep a lookout for hostile Indians. It is interesting to note that with all their outrages the Yaquis have never yet wrecked or held up a train nor cut a telegraph wire.

From Corral one line of the railroad follows the Yaqui river northeasterly to Cumuripa, to which point trains now run, but the road is to be continued through to Nacozari, where connection will be made with the Nacozari Railroad which connects with Douglas, Arizona. Along this route there is much heavy rock work to be done and it is not expected to get trains to running through probably before 18 or 20 months. From this line at or near Cumpas a branch will run westerly to connect with Cananea where are located the famous Greene properties now in the Cananea Consolidated group. Cananea is now reached only by way of Naco, Arizona, over the Cananea, Yaqui River & Pacific, the first part of this system constructed. From Del Rio on this line, a few miles north of Cananea a line is being constructed northwesterly to Nogales. These lines so far described completely circle the Yaqui country, that territory of mystery and outrage which contains enormous mineral wealth now almost wholly unexploited on account of the hostile Indians.

Character of the Country

Returning to Corral, our junction point, the railroad runs through a flat, wonderfully fertile country, between the Yaqui and Mayo rivers to Navajoa. This country needs only irrigation from these two rivers to develop into a very rich ranching country. Already on the rivers, nearer the coast, Americans are beginning to farm with steam plows and other American machinery; but they are only the pioneers and compared to the country's possibilities they are practically unnoticeable.

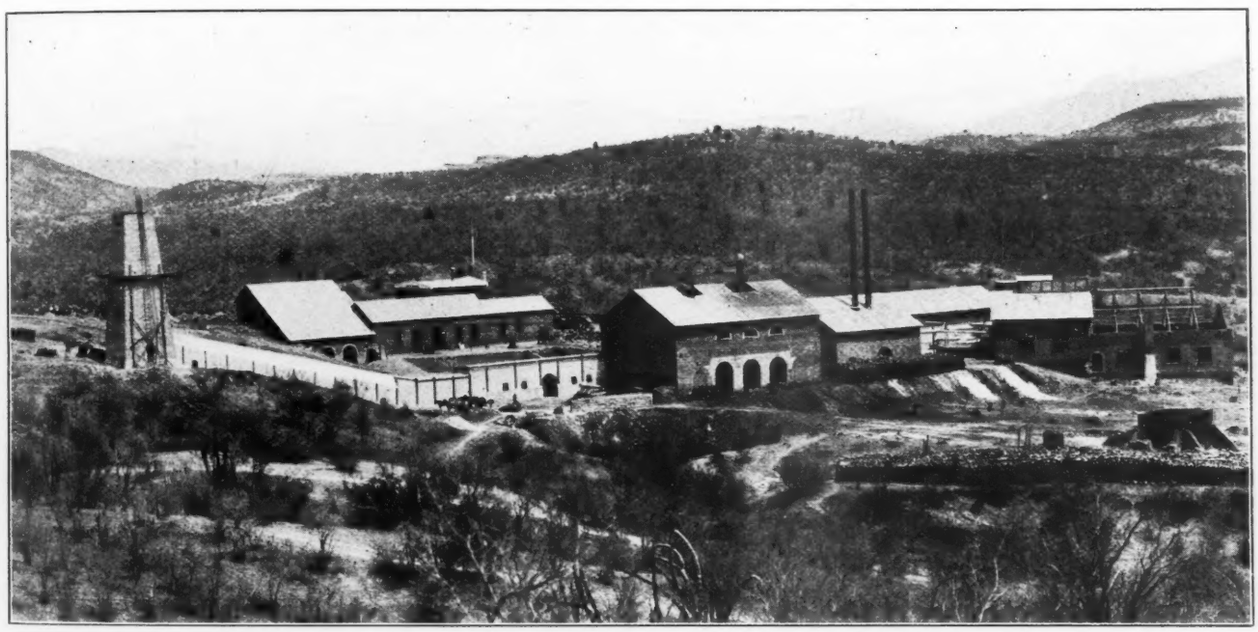
Navajoa is another junction point. A branch line from here runs easterly to Alamos, the former capital of the State of Sonora, which now has daily train service. Alamos has been a mining center for many years. Its mint records show marvelous productions of mineral wealth for several generations from properties some of which are not only now lost but others entirely forgotten and still others that have been producing continuously for 150 years. Alamos has a population of about 10,000 and numbers many wealthly and educated people. It has large stores and for years it has been a distributing point for mining supplies brought in by mule trains from the seacoast ports on the west.

From Navajoa the main line runs south and crosses the Fuerte river at San Blas to which point trains now run. At this point also the Cananea, Yaqui River & Pacific crosses the Kansas City, Mexico & Orient railroad. Continuing south this road will pass through or near Culiacan, will have a branch to Mazatlan on the coast, and will terminate at Guadalajara which is now connected by rail with the city of Mexico.

From Guaymas to Guadalajara all the country is practically virgin and much of it has never been visited by white man. These railroads, passing through some of the finest oak timber on the continent, are laying their rails on oak ties imported from Japan. Much difficulty has been experienced in getting labor. A ship load of Manchurians, Chinamen and Russians were imported but they caused a lot of trouble and many of the Chinamen got into the United States.

Kansas City, Mexico & Orient

The Kansas City, Mexico & Orient railroad will extend from Kansas City, through Chihuahua, across the Sierra Madre mountains and thence along the Fuerte river to Topolobampo on the coast of the Gulf of California. This road is now operating trains on both the Topolobampo and Chihuahua ends and has only 120 miles to build to connect the two sections and complete the work. But this uncompleted section presents the greatest engineering difficulties of the entire system, the crossing of the Sierra Madre range. The mountains are the highest, roughest and steepest in Mexico. However, the work is in progress and American engineers are doing the work.



SMELTING WORKS, YAQUI SMELTING AND REFINING COMPANY, SONORA, MEXICO

The deltas of the Yaqui, Mayo and Fuerte rivers taken together give an area greater than that of the delta of the Nile and the soil is so fertile and the amount of water so copious that the farming possibilities of this section seem to be limited only by the imagination.

The railroads will lay this virgin country wide open and with its timber, its capability of supporting an enormous population and its vast mineral wealth, it is safe to predict that the next few years will see a wonderful development in this section.

Mining.

From Cananea on the north the entire west slope of the Sierra Madre range is highly mineralized and contains many already famous mines, an account of which would extend this article beyond its lim-

its and even a brief mention of all the other mines of promise along this range and in its westerly foot-hills, all of which will be more or less benefited by these new railroads, would require a volume in itself.

Cananea and its copper mines are so well known as to require no comment here, but the southern part of the Cananea district needs transportation and this territory will profit greatly from the new branch line from Cumpas.

Mines in the Yaqui Country

South of this district is a most interesting mineral region, at present almost wholly idle on account of the Yaqui Indians. Much has been written of the Yaquis but most accounts fall short of the truth. When El Paso had only one street and had only stage connection with the mining territory in Mexico, the Apache Indians infested northern Chihuahua and Sonora and they were never other than hostile. At that time the Yaquis were a pastoral, highly advanced tribe. They did business with miners then operating there, kept accounts correctly, were industrious, honest, and peaceable. Like the American Indian they were driven farther and farther west until they not only were provoked to the same resistance our own Indians showed; but, being unable longer to raise satisfactory crops and cattle, they took to brigandage and murder. They have set back the development of that portion of Mexico 75 or 100 years. The Government is now deporting all the Yaquis it can capture to the peninsula of Yucatan where farm lands will be allotted them. Against those who resist deporting, a war of extermination is to be waged. With this present aggressive attitude of the Mexican Government toward them and the advent of the railroad, the Yaqui will soon cease to be a factor and this section of the country will be opened up.

Old Producers

The Yaqui country, especially the western and southern portion, has many ancient mines, now called *antiguas,* which were worked by the Jesuit fathers from the time of their earliest régime in Mexico. Most of these old mines have long been abandoned; a few have been reopened in recent years and one or two are still producing continuously.

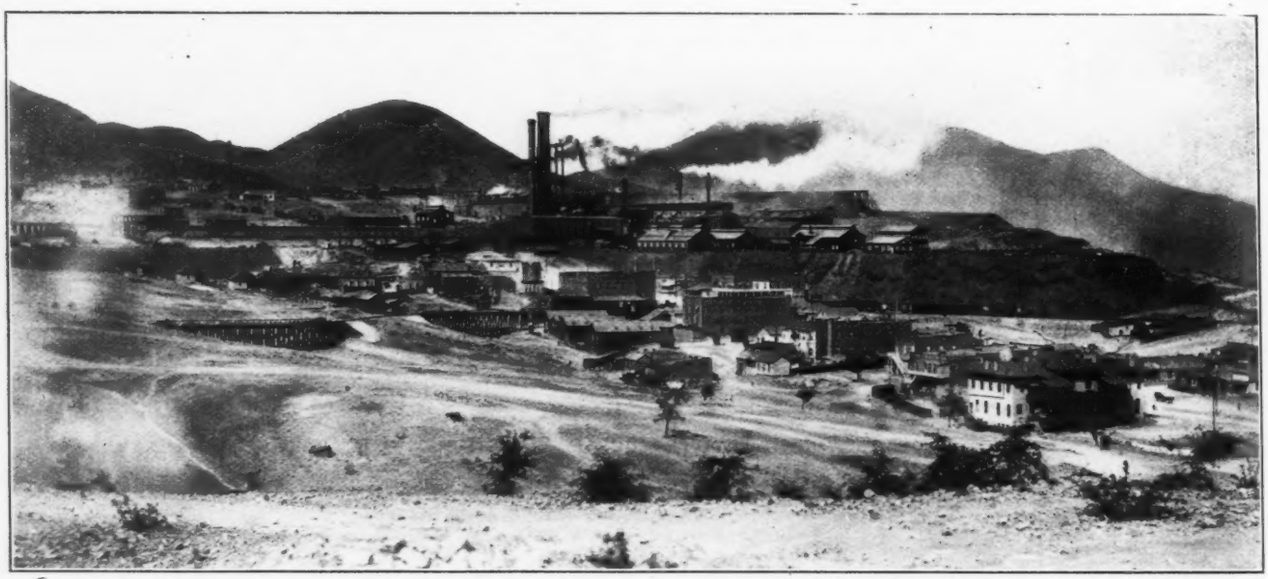
In the San Antonio district in the upper Yaqui country is located a most complete 250-ton lead-silver smeltery and refinery. This plant was designed and constructed by Frank Davis, to whom I am indebted for the accompanying photograph of the plant. When construction of this plant was begun it was outside of the country in which the Indians were committing outrages; but they soon made work there very hazardous and within a short time after the plant's completion the company was forced to abandon all operations. The plant has now been idle for three years but the Indians still visit it occasionally to pick off a watchman or two. When the railroad reaches this point as it should do in a year and a half, this district should make a good showing. La Dura mine in this vicinity was worked to a depth of 1000 ft., and produced several million dollars. The Bufa also has a fine record. The Tehramaya is another old mine of peculiar interest in this district; 20 or 25 years ago it had produced two or three milion ounces of silver. Just below the 500-ft. level a 6-ft. vein of anthracite coal was encountered and the silver value vanished, whereupon the mine was abandoned. The Plomosa is a lead mine of no little promise here and from it was intended to be drawn most of the lead ores needed for a collector in the smelter.

In this territory are several anthracite coal deposits which were acquired by the Southern Pacific Railroad several years ago and this is one reason why that railroad is building through that locality. The new line will afford an outlet for the mines which have been prospected sufficiently to prove their merit.

South of the Yaqui River

Farther south in the mining country between the Yaqui and the Mayo rivers the most important section at present is at El Cobre where are the Anita mines of the Douglas Copper Company which has a new 250-ton copper smelter 30 miles to the south on the railroad at Fundicion. The Anita mines have several million dollars worth of copper ore ready for stoping when the smeltery is blown in. Here also is another promising group of copper claims, the Josephine being developed by A. R. Blackburn. The copper ores of this camp occur, on the surface in the brecciated ferruginous gangue in the form of carbonates and chrysocolla rich in silver and containing some gold; they turn to sulphides at a depth of less than 250 ft. The average of the ores is about 10 per cent. copper.

In this camp are two *antiguas* with interesting records. The Mina Grande, opened to a depth of only 200 ft., was worked as far back as 1745 and has produced more than 1,000,000 oz. silver. The Tarasca, which was worked by the Franciscan monks and also has a large production record, has on the property the remains of an old smeltery and a very well preserved *arrastre* and several large circular reservoirs constructed of stone Neither of these two mines is working



SMELTING WORKS, CANANEA CONSOLIDATED COPPER COMPANY, CANANEA, SONORA, MEXICO

at present. The old cathedral at Quiriego had a wealth of silver ornaments and decorations together with bullion silver in its vaults and the story of its depletion by successive raids by Indians, French, Mexican renegades and outlaws is indeed thrilling. All the silver came from this camp.

Alamos District

Farther south and across the Mayo river one is in the heart of the Alamos mining district which has a fabulous record of production at the Alamos mint. Alamos has had its railroad only a few weeks. Heretofore all its supplies were hauled in from the coast from Agiabampo and Guaymas, a haul of several weeks. From here were freighted supplies to the Chinapas district and its famous Palmarejo mine now operated by an English syndicate. From San Bernardo, the end of the wagon road from Alamos, supplies are taken in on burro trains to these mines. In the plaza at San Bernardo today one can see coke which cost more than $100 per ton and has lain there so long that the sacks have rotted away; much of the coke has been burned by the Mexican inhabitants. This does not speak well for the management of the various mines; but it shows what bonanzas some of these old mines must be to stand such utter lack of method.

In this district is the Cerro Colorado, an *antigua* with extensive workings so old that they are filled to nearly the top of the drifts with bat guano. The dumps of this mine have been worked over and over by *gambucinos* for the rich silver ores which they contained. Samples from these dumps gave me assay returns of more than 400 oz. silver to the ton. The Piedras Verdes, a copper property of much promise and now under option to Los Angeles people, is located in this district.

About eight miles from Alamos is the Quintera mine, which is said to have produced 42 million ounces of silver. It has been operated continously for 150 years. first by the *antiguas,* than by Mexicans, later by an English and now by a French syndicate. It has a rattletrap plant but turns out satisfactory dividends for its French stockholders who are too far away to criticize details. The property has 16 levels, 30 meters apart. The ore has not yet been found on the bottom level. The Zambona and the Promontorio, one on each side of the Quintera, have also long and rich records, but are not opened up so extensively. Each of these three has a 20-stamp mill, that of the Promontorio just being installed.

South of the Fuerte River

Proceeding south and crossing the Fuerte river one enters an almost virgin country. It has been impossible to operate anything there except such properties as the Batopilas because of the lack of railroad transportation. All supplies were freighted to Choix from the west coast where they were brought by ship, mostly from Europe. From Choix supplies were packed seven and eight days' journey to points as far away as Guadalupe Calvo in southern Chihuahua.

On the north side of the Fuerte river, at the confluence of the Chinapas and Batopilas rivers, is the Lluvia de Oro, which with $6,000,000 blocked out in the mine, bears out its name of "Rain of Gold." The company operating this mine is spending $50,000 in the construction of a wagon road from Choix, and has a large mill nearing completion. It should show a large production this year. In this locality is the old Salsipuede mine worked by the *antiguas* ages ago. Here are ruins of two old smelters with hundreds of tons of slag running 6 to 12 per cent. copper, and high in silver; also remains of old *arrastres,* but not even a tradition of who the operators were.

This locality is the beginning of the gold belt which lies along the Durazno mountains where are the Calabacillas, El Tesoro, Oro Fino and other mines, some working and some idle. Here my trip ended. This brief article is not intended to tell the whole story of the country passed through, but merely to show what marvellous opportunities exist in this hitherto little known territory of enormous extent which is now being opened up by American railroads.

The Petroleum Industry in Mexico

Special Correspondence

Recent developments in the oil business in Mexico point to a warm fight between the various oil interests of the country. The entire business in all classes of mineral oils has long been in the entire control of the Waters-Pierce Oil Company, a branch of the Standard Oil Company. Of late years, however, an enormous amount of development work has been carried on in the states of San Luis Potosi, Tamaulipas and Vera Cruz, and excellent wells have been obtained, and late last year it was stated that a large combination had been effected between the principal holdings in these three states and the Mexican Petroleum Company, in the state of San Luis Potosi by E. L. Doheney, with a capital of $50,000,000 gold. Whether or not this combination has been effected, certain it is that one or more strong companies are in operation in that section of the country and many of the Mexican Central railroad engines are running with oil from these fields as fuel.

More recently than the developments in the San Luis Potosi and adjoining oil fields have been those on the Isthmus of Tehuantepec, along the line of the Tehuantepec National railroad, by S. Pearson & Son, the contractors and builders of that railroad. The wells bored are many and strong and the Tehuantepec National railroad is using the oil therefrom as its fuel. At Minatitlan, S. Pearson & Son have been for some time busily engaged in the erection of the largest refinery in the Republic at a cost of several millions, and it is expected that the plant will be completed within the next two or three months. In connection with the refinery are about 40 storage tanks of various sizes ranging from 6x30 ft. to 9x30 ft., the largest having a capacity of 42,000 gal. From Minatitlan, S. Pearson & Son have a railroad connecting with the Tehuantepec National at Kilometer 30 and thence to the wharves at the port of Coatzacoalcos. The company therefore has ready access to Central American and South American trade, as well as the Gulf ports of the United States if desired, having as it has, its own tank steamers.

It is stated also that a 42,000-bbl. storage tank is being erected at Vera Cruz, and that ground is being acquired in Mexico City and other points throughout the Republic on which to erect storage tanks, and by the time these arrangements are completed the Minatitlan refinery will be ready to do business.

It is there, it is believed, that the fight will be opened, and it is not known whether a three-cornered fight may be expected or whether the San Luis Potosi company or companies will join forces with S. Pearson & Son or remain outside and let the struggle be fought out between the Pearsons and the Waters-Pierce company. The Pearsons are a wealthy English company, and already have about ten millions Mexican invested, and the head man of the oil department is T. J. Ryder, former general manager of Waters-Pierce company in Mexico. He is therefore fully informed as to his competitors' tactics.

Mexico can, of course, derive nothing but good from the contest and the resultant reduction of cost of oils. The Pearsons will undoubtedly give a great deal of their attention to export trade, for the Minatitlan refinery is to have a capacity of 5000 bbl. a day while the demands of the Mexican market are at present only about 1000 bbl. a day.

The average content of the ore mined at the Le Roi mine, Rossland, British Columbia during the year ending June 30, 1907 was, according to the company's report: Gold, 0.29 oz. per ton; silver, 0.44 oz.; copper, 0.98 per cent.

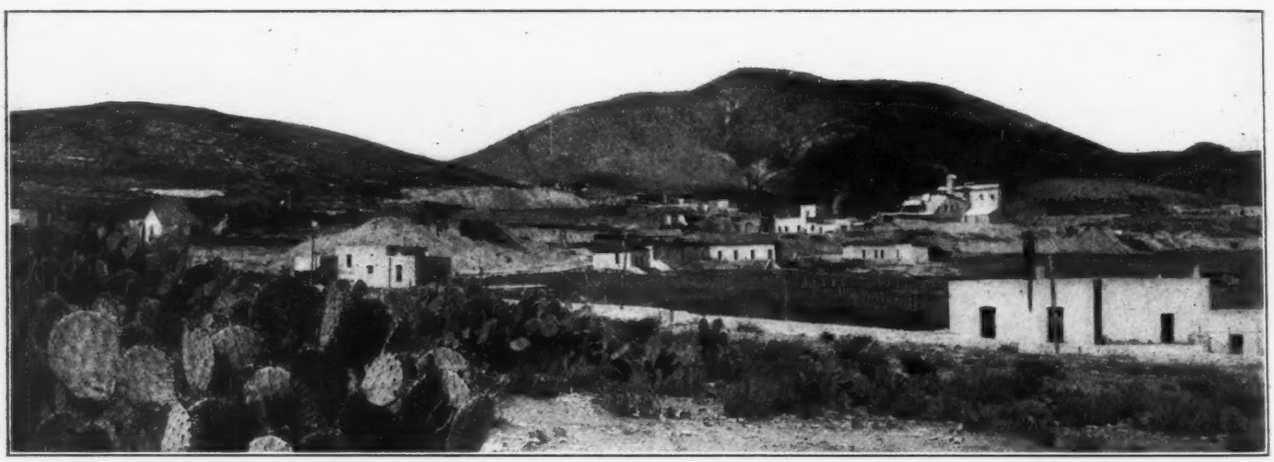
The breathing apparatus for rescue work in mines should be air-tight as far as the passage of air from outside to inside is concerned. Yet in most circumstances met with in mines, a very small leak does not necessarily render the apparatus useless.

Separation of Mixed Sulphides at Charcas, San Luis Potosi

By R. C. Canby*

The Compañia Minera del Tiro General, at Charcas, San Luis, Potosi, Mexico, has in operation a novel plant for the treatment of the highly zinkiferous copper-lead ores. For some years past, the company has been shipping from three to four thousand tons per month of copper ores to Aguascalientes, with occasional cars of sorted lead ores to Monterey.

The average of zinc content has been kept just below the 8 per cent. penalty limit, by the admixture of suitable proportions of oxidized ores from the older surface workings. The available quantity of this surface ore was, however, insufficient to permit the extraction of many of the large bodies of zinc-blende ores.



PROPERTIES OF COMPANIA MINERA DEL TIRO GENERAL, CHARCAS, SAN LUIS POTOSI, MEXICO

I was called upon to determine if such a plant of magnetic separators as I had installed at the Montezuma Lead Company's mill, would be available. Owing, however, to the character of the zinc blende of the Tiro General, it being largely the so-called "rosin-blende," it was found impossible to make a reasonable proportion of the zinc into a marketable product. There was not, besides, available, a sufficient supply of water to carry on concentrating operations upon any considerable scale. Some entirely radical departure from the ordinary methods, was necessary and this was found in the Sutton, Steele & Steele process.

A small plant of this pneumatic system, was at that time in operation near Sierra Blanca, Texas. A trial run made at this mill, gave such surprisingly excellent results, that it seemed imperative to confirm them. For this purpose, a couple of the Sutton-Steele tables were put into the old abandoned mill of the Tiro General Company at Charcas. The work of the tables upon this experimental run, more than confirmed the previous work of the concentrating tables.

Experimental Plant.

The installation of this experimental plant, which was designed simply for confirming the efficiency of the table, did not embrace in its scope, the features which, in the subsequent construction of an operating plant, proved the most difficult of solution.

The Sutton, Steele & Steele dry-concentrating table showed that it had a capacity of over 40 metric tons upon the coarser sizes, down to 12 to 15 tons on the finest mesh, and that the separations were very much sharper and the tailings 50 per cent. cleaner, than on wet tables. We found that we could count upon a 45-per cent. zinc product from the tables, while with the present mill operations, 50-per cent. to 53-per cent. zinc is being produced, with high-grade concentrates.

The compactness of design, which might otherwise have been attained, was sacrificed by the utilization, as far as possible, of the old mill building, the desirability of utilizing this old mill being emphasized by the fact that it had side walls of masonry 1 m. thick. All of the crushing and screening department is comprised within this older building, the new table room being of light frame and corrugated-iron construction, across the end of the older stone building.

The ore, coming direct from the mine or from the ore-sorting patio, is dumped at ground level, into a 10x20-in. Cananea-type, Blake crusher, passing thence by elevator to a 1⅛-in. grizzly over the mill-feed ore bin, the oversize from the grizzly passing through a smaller Blake.

The ore is fed from this bin through a shaking screen feeder, to roughing rolls and elevated to a ½-in. trommel on top of the shaft dryer, the oversize returning to the oversize rolls and to the same elevator.

This shaft dryer is similar to that which I installed for drying Wifley table middlings for magnetic plant at the Montezuma mill, and is simply a shaft 6x3½ ft., and about 30 ft. high, having longitudinal deflectors for arresting the fall of the ore. The top is trapped so that a current of air moved by a No. 6 fan, is drawn through a heating grate at the bottom. Thus a large volume of slightly heated air produces a maximum drying effect, with a minimum of fuel.

For the finer crushing, there are three sets of so-called El Paso Foundry "convertible rolls," which I designed especially for this plant; they are used as rigid rolls, in tandem with 3/16-in. trommel, and Colorado Iron Works "Impact" 16-mesh screen in train, the flow being such that all material of given size is removed before passing to its respective roll. These rolls are exceeding all expectations as to smoothness of action and efficiency. The final roll reduces to 26-mesh.

Difficulties of Operation

One of the most difficult problems to solve was that of the proper removal and collection of the dust. It was found that a mechanical throw, in connection with a suitably regulated air current, was necessary; and upon this idea is constructed the dust separator through which all material passes in transit from the final roll to the elevator leading to the screen tower. Of the dust product from this separator 98 per cent. passes through 200-mesh. The air for this separator is drawn from roll housings and elevators, so that there is no perceptible dust in the mill. The dust from the separator is collected in a collector of the cyclone type, and is reserved for special treatment.

Screening has been one of the most difficult problems. Since it was a concentrating mill, we looked to what we

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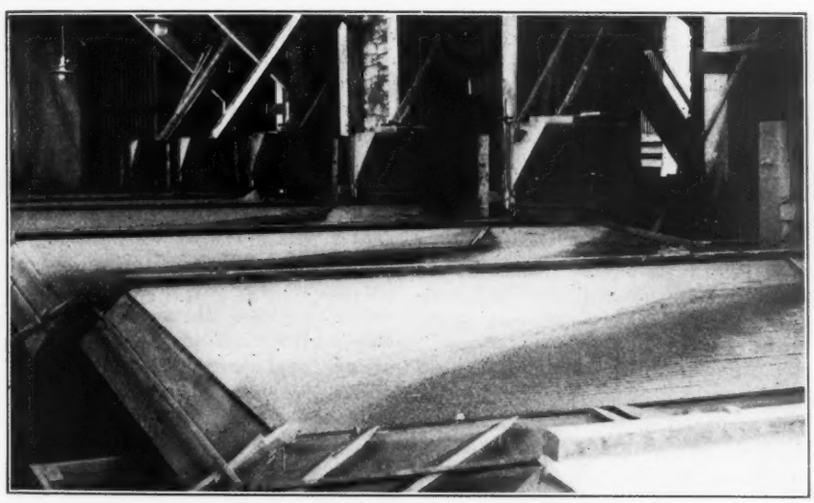
considered the best recognized form of mill screen; but were disappointed in capacity, efficiency and durability of those types. It was found that for such fine, dry material, the flour-milling industry had the most to offer; the so-called Sutton, Steele & Steele vibromotor ore sizer, which has recently been installed in the mill, is simply an adaptation of the Allis-Chalmers vibromotor flour-mill sizer or bolter. The results, so far, are quite satisfactory. The work done by this form of screen is perfect, but we have yet to determine by greater experience, just what forms of screen cloth are the most economical.

It is difficult for one unfamiliar with dry sizing, to appreciate how very little wear dry material offers, as compared with wet. It is difficult to grind an ax upon a dry grindstone. The principle explains the difference between wear upon wet and dry screens. It is, curiously enough, a general impression that dry crushing costs more than wet; this is erroneous, it being decidedly the reverse.



SUTTON, STEELE & STEELE DRY CONCENTRATING TABLES, TIRO GENERAL

The vibromotor screens size the material passing 26 mesh, into five sizes: 26 on 34, 34 on 46, 46 on 60, 60 on 70, and through 70 mesh. These sizes each go to separate bins, for their respective tables.

Products

From each table is cut a lead concentrate and a zinc product, which pass through pipes directly into shipping sacks, on the lower floor. The tailings pass from the tables upon 8-in. Robins conveying belts and to the tailings bin.

From between the lead-iron streak and the zinc, and from between the zinc and gangue, are cut small streaks of middlings. These are run together into a middlings conveyer, all middlings going by conveyer and elevator to the middlings vibromotor sizer, and are re-sized into 10 sizes and delivered into middlings bins, where material is drawn for alternate treatment upon four middlings tables for retreatment.

There are in all, at present, 10 of the Sutton, Steele & Steele concentrating tables, six on concentration and four on middlings, although by cross connections, some of the tables can be used for either.

From the rosin-blende ores high in copper, the table-zinc product is retreated upon the Sutton, Steele & Steele dielectric separator. This department is still experimentally arranged, but its importance seems beyond question. Both the Sutton-Steele table and the dielectric separator were previously described by me in the JOURNAL, May 12, 1906.

The Dry Table

The Sutton, Steele & Steele dry table resembles in general appearance, the ordinary types of wet tables, with the deck 12 ft. long, and 5 ft. wide. Through the pervious bottom passes a constant current of air from a rotary fan, the air being drawn from a general air main. The reciprocating movement of the table causes the separation. An article in the JOURNAL of Sept. 17, 1907, gave detailed description as to construction.

The dielectric separator, while a static separator, differs from all previous types, in that the electrical conductivity does not enter into the separation. Particles under the influence of convective discharge from a series of charged needle points to a grounded roller, cause certain minerals to adhere continuously to the roller, while other mineral particles are unaffected. In the case of the Tiro General ore, the rosin-blende adheres tenaciously to the roller, being removed by rotary brushes, whereas the chalcopyrite, iron, etc. fall over upon a separating shutter.

The screening capacity of the mill is still inadequate for the table capacity or crushing capacity, but the use of the vibromotor screen was so novel, that it was considered best to prove its economy by actual use, before installing sufficient for the full mill capacity.

There were many details to be worked out and demonstrated, but everything is now working without a hitch. The same process is also in use at the Calera mine in Chihuahua. At this mine, however, screen sizing is not resorted to, but pneumatic classification is substituted, and the final zinc product is made upon Wetherell magnetic separators. The Tiro General plant, however, is an example of the complete system with sizing and of final dielectric separation of copper from the rosin-blende product.

The State of Sonora

Consul Louis Hostetter, of Hermosillo, furnishes the following statistics for the State of Sonora, as given in the report of the retiring governor, Hon. Rafael Ysabal:

The State of Sonora has a population of 214,029, divided among the districts as follows: Alamos, 61,318; Ures, 26,191; Hermosillo, 24,510; Moctezuma, 22,104; Arispe, 17,955; Guaymas, 16,731; Magdalena, 16,082; Altar, 15,917; Sahuaripa, 13,181.

There are five railroads in the State: (1) The Sonora, from Nogales to Guaymas, 265 miles; (2) the Torres and Prietas, 124 miles; (3) the Nacozari, from Agua Prieta to Nacozari, 77.7 miles; (4) the Cananea, Yaqui River and Pacific, from Naco to Cananea, 38.5 miles; (5) and the same road from Empalme to Buenavista, 132.4 miles. This last road, or branch, is building to Guadalajara, and is gradually opening to the markets of the world a very rich country in mines and agriculture.

Mining is the chief industry of the State. Irrespective of the hundreds of small companies, the mines were operated during 1906 by 122 large companies, of which 96 were American.

Pulsometer pumps, according to the *Engineering Times*, Feb. 13, 1908, are not economical in steam, nor are they adapted to high lifts. For pumping against a head of 20 to 40 ft., the steam pressure should not be less than 20 to 30 lb. per sq.in.; for lifts from 40 to 80 ft. high, 30 to 50 lb. The suction should not exceed 10 or 15 ft. though, if necessary, it can be as great as 20 ft. The chief advantages of pulsometer pumps are the freedom from breakdown, simplicity of parts, and their ability to handle water containing dirt and grit.

An estimate of the consumption of portland cement in Canada for the last seven years shows an increase from 872,966 bbl.—of which 555,900 bbl. were imported—in 1901, to 3,041,223 bbl.—of which 672,630 were imported—in 1907.

Character and Habits of the Mexican Miner

He Is Patient, Good Tempered, Careless of Danger and Fond of Amusement, and Works Only to Supply His Necessities Which Are Few

BY ALLEN H. ROGERS*

One of the most important factors in the operation of a mine in Mexico is the Mexican mine laborer. The increase in number of mining operations in recent years has been so great as to make the securing of an adequate supply of labor a difficult problem. In other words, there are not enough miners to go around, and, as there has been an increased demand for labor in agricultural operations and other lines of industry, it has been difficult sometimes, to eke out the supply for mines by drawing from other classes of labor.

The manager who best understands the Mexican peon is the man who will get the most done for the least money. Of the many instances of failure among American mining enterprises in Mexico, some, at least, have been due to lack of understanding on the part of the management of the labor problem, and my object in the present instance is to say something regarding the Mexican laborer's character, ways and work and, incidentally, to try to point out ways to follow and errors to avoid in dealing with him.

Ethnologically, the Mexican of to-day represents the fusion of the race of the Spanish conquerors with the indigenous tribes. The latter, while of the general American race, were as diversified in Mexico as in the territory now occupied by the United States. The preservation in such fusion of the original inhabitants of the country is one of the points in its history most in contrast with that of the United States. It was in part due to the superior stage of culture to which some of the Mexican tribes had attained, but, in still greater part it was due to the policy of the Spanish home government which aimed to preserve the Indians and which, indirectly, fostered the intermarriage of the two races. King Ferdinand in 1514, approved of the marriage of Spaniards with the Indian women of the Islands and later legislation discouraged the emigration from Spain to the colonies of unmarried women, the king reserving to himself the power to grant licenses in such cases as were to be made exceptions. All trace of the distinction between the various tribes has been lost in this fusion and as to proportions of Spanish and Indian blood, there are almost as many as there are individuals. The native blood largely predominates in those of the lower class, however. Generally, it may be said of all classes, that no especial pride is felt in a high proportion of Spanish blood; in fact, where any pride of descent is felt at all, it is by those of pure Indian blood, but this, perhaps, is brought about by the antipathy felt to the *gachupin*, as the Spanish immigrant is called.

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Peon System

Historically considered, the Mexican laborer has come up from what was practically a state of slavery. At the time of the discovery of America, the Spanish authorities at home were very solicitous as to the state of the Indians, and Columbus, as first viceroy, and others who followed him in the government of the West Indies, were charged to treat the Indians as free men; to neglect no influence which would civilize and Christianize them. But the financial difficulties of the colonies and the greed of the Spanish settlers speedily caused a disregard of these instructions so that, where not actually enslaved, the Indians of the Islands were distributed in *encomiendas*, an arrangement under which each Spanish settler was assigned a certain amount of land with the right to the labor of the Indians who lived upon it. This system was transferred to Mexico, though after the promulgation of the "new laws" in 1562, it was modified and regulated, the absolute enslavement of the Indians in the future being prohibited and the expiration of the *encomienda* system being provided for by the death of the holders. Before these regulations could fairly be put into effect, however, it was arranged that the system should go on for four generations, and, later, further extension brought its conclusion into the eighteenth century. In some cases under this system, the Indians might discharge their obligations to the *encomendero* by the payment of tribute money.

One of the special services which the Indians were to render and, as such, was dealt with in the code, was work in the mines. The Indians were assigned to this service by a lottery called the *mita*, and under the regulations providing for it, only four Indians out of each hundred could be assigned to it at one time. For this, as for all other services they were to receive wages and an Indian could not be drafted again until all his fellow villagers had completed their turns. It is probable, however, that this provision, as well as the others of the laws for the protection of the Indians, was very loosely administered, or disregarded. Indeed, it is a recorded fact that in Peru the Indians were reduced to absolute slavery and while no specific statement that such was the case in Mexico has come to notice, the inference from reading Las Casas and other writers of colonial times is that it was.

The peonage laws, which existed until comparatively recent times, indicate that such was the condition in Mexico. Under these laws, the proprietor of the land could exact work from his laborers as long as the laborer was in debt to him, a condition which the proprietor took care should be perpetual by furnishing him with rations and loaning him money at a high cost. The word "peon" properly means a foot soldier and its use for laborer very likely came about through the compulsory service which he was obliged to give. Peonage has been prohibited for a good many years. but the peon in debt in many cases still recognizes more of an obligation to the powerful landholder than its mere discharge in money or goods. Its effect is also noticeable in all the laboring class in their lack of thrift and thought for the future, depending, as he used, on the *patron* for daily sustenance.

The Miner

Among Mexican laborers, the miner and mine laborer until recently constituted a special class and to some extent this is still true. The inhabitants of the large mining districts were, of course, mainly miners from father to son. The agricultural peon was of quite a different character. Owing, as he did, allegiance to the *patron*, the proprietor of the *hacienda* or plantation where he was born as his father before him, he was of mild and humble nature, much like the Southern plantation field hand before the war. He worked from sun to sun and his diet was rarely, if ever, anything but corn, beans and chile. Again, like the Southern darkey, he lived in quarters at the home ranch or at outlying ranches under the supervision of a *majordomo* and from working constantly in the sun his skin, naturally dark, was blackened to the hue of the African.

The miner, on the other hand, he who had spent his life underground and for generations had known no other work. was as pallid as his dusky skin or the accumulation of dirt permitted. He feared

the sun which, he said, did him harm. He was rather turbulent in disposition, given to drinking much of the native liquors, and was handy with his knife. Still, he was always respectful to his superiors and readily accepted from them and abided by decisions not always just to him. Stripped of all but a breech clout and sandals, he worked in narrow, ill-ventilated and badly supported workings and, with the opportunity to divert himself at night in dancing, gambling or brawling, accepted his lot cheerfully.

In recent years, the demand for labor in mines, as well as in other lines of industry, has led the agricultural laborer to seek work out of what was formerly his proper sphere. This, in turn, has caused the planter to offer increased wages and better conditions to his labor, especially at planting and harvest time so that the line between the two classes is much less sharply drawn. Most of those who have operated mines in Mexico can tell with woe of the general exodus at such times and it is partly for this reason that a dry season is beneficial to the mining industry in limiting the demand for labor on the plantations.

All of the lower-class Mexicans are of a contented disposition, of little or no ambition beyond that of obtaining the needs of the day, with perhaps a few centavos to spend at some *fiesta* on *mescal*, or with which to back a cock. Lacking ambition to better his condition, the *peon's* only incentive to work is the necessity of living. So he will generally work only long enough to keep himself and family supplied with the necessaries of life and no more. In consequence, an increase in the wages paid him often results in less accomplished because he does not have to work so long to get his living. And even the steadiest workers among them want Sunday for play. All are fond of amusement, which takes the form of hand ball and other simple games, almost invariably for stakes, cock mains and bullfights. They like to be where there are others of their kind with the inevitable *plactica*, or gossip. They are also very fond of music. Deprived of these pleasures, they become discontented and move on to some place where such attractions are available.

Morals and Customs

In his home life, the Mexican laborer is little considerate of his wife, whose condition is much like that of the Indian squaw. But he is very fond of his children and it is a source of pride to have a large number. Large families are not common, however, owing to the high death rate among infants. Boys are more prized than girls because they help to support the family as soon as working age is reached. This used often to be less than 12 but the compulsory education laws deferred to some extent the age at which boys can be put to work, with physical as well as intellectual benefit to the race. One of the most important duties which the peon recognizes is that of supporting his aged parents and it is general faithfully observed.

The standard of morality is decidedly low and a great many live with women and have children without the sanction of either law or religion. This may be ascribed in part to the fact that the church, the blessing of which Mexicans, especially the women, regard as essential to the perfect marriage, makes her sanction costly. The prospective candidate must qualify himself by examination in the catechism, which involves a feat of memorizing of which a good many are incapable or for which they are disinclined. Further, the *padre* takes good care to find out to what limits he can press the claims of Mother Church for financial compensation for her blessing. The limit is generally the ability of the candidate to pay. The legal ceremony, that performed by civil officials, while the only one recognized at law, is regarded as of no value by the good Catholics so that, with the religious ceremony beyond his abilities or energies, the *pelado* contents himself with a mutual agreement. Generally, this lack of legal or moral tie does not conduce to the shirking of responsibility on the part of the father.

The household arrangements are often of the most primitive and limited kind. The house itself may be anything from a rough shack, or *jacal* as it is called, constructed of loose stones with a thatched roof and of one room to one of adobe or rock and mortar construction of two or more rooms. The essential furniture consists of the *metate*, a stone somewhat suggestive of the assayer's bucking-board, for grinding the boiled and hulled corn of which the *tortilla* is made, the *comal*, a sort of clay frying pan, sundry urns, jars and other utensils of the cheap native pottery, and the bed which may be only a matting made from the leaf of the *sotol*, a palm-like variety of the agave. The kitchen fire is built on the floor in a corner, the smoke finding its exit as best it may, while the family meal is served on the floor or outside. Of course, the standard of living is constantly rising now, but many of these people, those of the mining class especially who are constantly moving about, live in a chronic condition of camping out and it is astonishing with how little the Mexican women will keep house.

In matters of hygiene, the *peon* is absolutely ignorant, of course, and in mining camps it is one of the hardest problems to keep the place clean. Fortunately, the dry climate and hot sun do much to counteract the unhealthful conditions brought about by filth. Nevertheless, the poor food, the exposure during winter, and constitutional diseases make the death rate high, especially among infants. A Mexican mining camp is the delight of the young American doctor; what with the number and variety of diseases and the surgical cases resulting from mine accidents, he is certain of an interesting and varied practice.

His Value as a Miner

In the matter of work, the Mexican miner does not equal in quantity or quality, the white miner. The real miner is generally a skilful hammer-man but his blows lack the force of the old-time Cousin Jack. Single-jackers are far from common among them, a great proportion of the work being done double hand. It is not common to find men who can work overhead and in many districts it is impossible to get a vertical raise put up. So it is generally cheaper to sink a winze and muck out with a windlass than to raise.

The Mexican miners are poor mechanics, and as machine-drill runners, while receiving much less pay than a white runner accomplish much less drilling and the machine suffers more, i.e., repair bills are larger. It is with much difficulty that they handle a 3-in drill and it usually is necessary to put two men on the 2¼-in. drill which is handled by one man in the States.

As car men and shovelers, they do less than white men, owing, as in cases of other work, to their inferior physique. Where one man in an American mine would handle a car, it is generally necessary to employ two Mexican trammers. In their own way of handling ore, namely, on their backs, they can carry weights which the American laborer would find impossible. This is due to their training which, as a result of such methods, highly develops the muscles of the thigh, hip and loin, leaving the shoulder and arm muscles little developed. Changes in mining methods now going on will undoubtedly alter the physical development of the Mexican miner.

Generally, underground, they are quite fearless, indeed careless; they will work where it is difficult or impossible to keep a light owing to bad air and a constant watch is necessary to keep them from killing themselves. The high proportion of accidents in Mexican mines is said to be due to lax and primitive methods and, while this is true to a great degree, it is to some extent due to individual carelessness. This is particularly noticeable when they are working for their own account as leasers or *buscones*.

Altogether, while the Mexican miner is much less efficient than his American

brother, a comparison of the cost of such work in Mexico (except where wages have been raised to a ridiculous rate as at Cananea) with that in the mining districts of the western United States, is decidedly to the advantage of the former. In recent years this has not been so marked as formerly for wages in the past 15 years have doubled. With this increase in wages has come some increase in efficiency, though not commensurate with the higher cost.

Treatment at Mining Camps

To the American manager who has to do his work with Mexican labor, I would say, regarding general policy, that, in order to get labor, he must make his camp or town attractive. It is of advantage to the company to house the men in clean and comfortable quarters and have them kept clean. Blocks of houses of adobe (the sun-dried mud brick) can be cheaply constructed. Each house consists of one or two rooms, usually one, the size of which in one dimension is governed by the length of the roof timbers available. Medical attention of some sort is of advantage to both parties. The cost may be provided for by a small monthly deduction from the pay of the man and the services of many a man are conserved to the company by prompt medical attention. Opportunities for the discharge of their religious duties should be furnished the men by providing the camp with a church or arranging for periodical visits of the curate. And if something is contributed occasionally to the *padre*, it will be found to be a good investment, for his good will in keeping the men at work is a valuable asset. No influence governs the Mexican *peon* to such an extent; if it does not reach him directly, it will through his women. The local civil officials, on the other hand, cannot affect one's situation one way or the other, provided one gives them simply their due and obeys the laws. It is true that some managers find themselves under the necessary of "squaring" some official in order to escape a fine for an infraction of the law through ignorance. In Mexico, as elsewhere, ignorance of the law is no excuse and it is one of the qualifications of a good manager to know the law; if he doesn't, he should seek legal advice.

Allow the men to have some time and means for recreation. It is a mistake to force them by fines or other means of chastisement to work every day in the month. No exception can, perhaps, be taken to the offering of bonuses for steady work but the majority of men will not take advantage of opportunities of this sort. For work that requires constant operation like the blast furnace, for example, with time a force can sometimes be got together that is fairly steady, but it is generally necessary to have a great many more men on the payroll than are actually at work. Records of years of work in different camps in Mexico show that each man worked about 15 days per month and this figure would be closely approximated whether operations on Sunday were carried on or not. On certain feast days, notably Holy Week from Wednesday preceding Easter until Monday morning after, most men absolutely will not work and it is often difficult to keep the pumps going at that time. An American who sets out to force his men to work on those days is butting his head against a stone wall. Besides refusing to work, his men are apt to move on to some other camp.

Intemperance

Among his vices, the most objectionable from the standpoint of the employer is his fondness for the native distilled liquor, *mescal*. And yet it is uncommon to find men who are sots. Without easy access to it, the *peon* gets along very well without it and it is always well to prohibit the sale of it, and to enforce such prohibition as far as possible. It is not possible to exclude it absolutely, even from the company-controlled camp but constant vigilance keeps it within bounds. Where it is sold freely, a good deal of time is lost by the men, it is not easy to keep drunken men out of the mine and a great deal of serious quarreling results from its use. As to other means of disposing of his money, I am inclined to agree with the idea that the sooner you get his money away from the *peon*, the better for him and the more work he will do. At the same time, the company store is very unpopular with the men and for the sake of the labor supply, it is usually better to arrange with two or more store-keepers to protect their accounts with the men. It is necessary to do this (unless paying off daily in cash, as is done in some instances) for the *peon* does not understand making one week's wages last for another week. In the company-controlled camp, it is well to give concessions for the construction of a hand-ball court, cock pits or the establishment of billiard rooms. An orchestra or band can often be organized among the men which, with a little help by subscription or otherwise, gives concerts Sunday evenings besides serving the local dancing.

In dealing with the Mexican laborer in his work, it is folly to expect of him either the quality or the quantity of work of the American. He does not compare in physique, ambition, judgment or intelligence with the latter. Much closer supervision of his work is necessary both because he will "soldier" and because he does not display the judgment in laying out and executing his work. Everybody understands the great difference in amount of work he will do when working under contract as compared with that at wages and wherever possible, he should be worked under contract, piece work or task.

The Dolcoath Tin Mine, Cornwall

Special Correspondence

The 13th annual meeting of the shareholders of the Dolcoath mine was held in London on Feb. 28. A dividend at the rate of 7½ per cent. per annum was declared for the half year ended Dec. 31, 1907. For the first six months the dividend was at the rate of 20 per cent. per annum, so that the total dividend for the year 1907 was 13¾ per cent. The drop in profits is attributed partly to the fall in the price of tin—almost £25 per ton on the six months—and partly to an increase in the cost of labor, coal and other supplies.

The sinking of a new vertical circular shaft, commenced several years ago, but discontinued owing to want of money, is now being resumed, and plans are being made for equipping the mine with more up-to-date machinery, especially in connection with the application of electricity. This famous old mine has now been working for more than a century, and is handicapped by small shafts and inferior equipment. An output of only 340 tons a day is all that this extensive mine produces. The completion of the new vertical shaft (Williams) is consequently of great importance. The depth of this shaft at the end of 1907 was 1680 ft., and a connection with the present workings will be made at 2940 ft., so that there are still 1260 ft. to sink. At 60 ft. a mouth—the past rate of sinking—connection should be made toward the end of 1909.

The accounts for the last half year show that the working costs were $6.3264 per ton on 49,794 tons crushed, or, excluding the royalty, $5.808. The costs are not worked out departmentally, and no information is given as to the cost of mining, milling, pumping, etc., as is the practice on nearly all mines of first-rate importance. The accounts merely show the amounts spent on wages, materials, royalty, salaries, etc., and are consequently of little value from a professional point of view. Another point in which the report is deficient is as regards the percentage of extraction. The recovery is given but not the contents of the ore as it comes from the mine.

The average produce per ton of ore from 1895 to 1907 has been 48.48 lb., or 2.16 per cent., of black tin. For the half year ended Dec. 31, 1907, the produce was 38.02 lb. of black tin per long ton of ore. In 1905 the produce was 79.19 lb., or more than twice that of 1907.

Present Cyanide Practice in Mexico

In This Transition Period Fine Grinding of the Ore, Filtering of the Slime, and Air Agitation Are Conspicuous in Treatment of Silver Ores

BY MARK R. LAMB*

Cyanide practice in Mexico is progressive and many of the newer developments of the process are being used. In Mexico the ores are less docile and the value of the ore treated probably averages much lower than in the United States for, although much rich ore is treated in Mexico, several large plants have been built to treat either old dumps or ores from *antiguas,* from which the rich ore was mined years ago. Probably the low value of the ore treated, by stimulating economy, is the cause of the great progress which has been made within the last year in the treatment of silver ores.

Although there are gold mines in Mexico, the large majority of the cyanide plants are treating silver ores. Even the camp of El Oro, where ore is much richer in gold than silver, may be considered a silver camp when viewed from a metallurgical standpoint. At Guanajuato the ore contains silver mainly. At La Luz, the ores contain more silver than gold by weight. In western Chihuahua, the mines are practically all silver. In fact, in the States of Sonora, Chihuahua, Sinaloa, Durango, Guanajuato, Hidalgo and Jalisco, which contain the districts where the most cyaniding is done, silver mines predominate.

As this is a transition period for the mechanics of the cyanide process, any endeavor to treat the subject exhaustively would be beset with many difficulties. Disconnected statements of facts will be worth more than an attempt at summarizing, but it must be remembered that probably important changes will be made at some of the places mentioned even before this is printed.

While it is intrinsically dangerous to hazard prophecy, it is also unfair to anticipate descriptions which others are entitled to publish, even though they fail in this duty to the craft. Figures belong to the man in charge of the plant, and though I have seen, during the last year, practically every reduction works in Mexico, whether smelter, concentrator, stamp mill or cyanide plant, and in most instances have been given data, this is presumed not to be for publication unless express permission is given. The reason for this apparent secrecy is not that the details of operation are not open to the public but rather that many of the managers plan to describe at some later time their own plants. The large majority, of course, never do this, and the valuable data which they have are tied up and lost except as concerns those fortunate enough to meet these men personally.

THE 160-STAMP MILL, GUANAJUATO REDUCTION AND MINES COMPANY

At Guanajuato, since Mr. Hamilton's first experiments on the cyanidation of these ores, the practice has been kept strictly up-to-date. The latest improvements in crushing, classification and treatment have been adopted, but only after they have been proved in other plants, and for a camp, where more than 600 stamps are in operation, remarkably few mistakes have been made in the design of the mills. There is a friendly feeling among the various operators which all realize is very helpful, a spirit which is not seen in every district. This feeling of co-operation is due largely to the fact that a number of the men in authority

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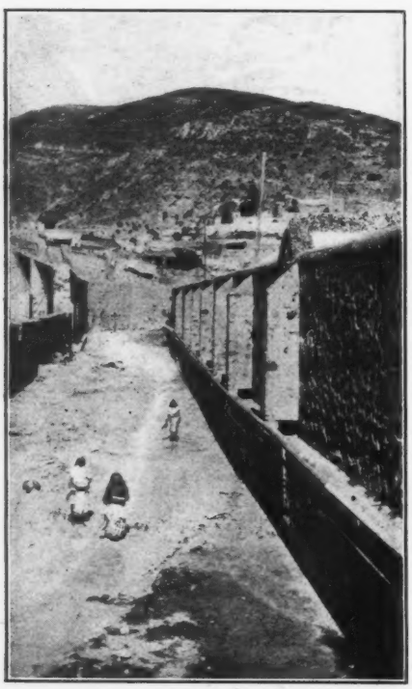
have worked at different times, for several of the companies.

It has been my endeavor in this description to cover the general features of the practice at Guanajuato and at Pachuca, and only to refer to interesting features of milling practice at other camps.

Ore Sorting

Ore sorting is most seriously considered at the plants of the Guanajuato Reduction and Mines Company, and the Guanajuato Consolidated Mines Company. The former company is now working an immense dump of ore, formerly considered too low-grade for treatment; it is, therefore, vitally necessary to sort out as much barren rock as possible. As the material is tumbled down from the dump it is discharged upon a wide belt; as the ore passes, women sort out apparently all the



INDIANS CONCENTRATING TAILINGS IN THE RIVER AT PACHUCA

waste, at least all the waste apparent to the eye. The ore is then trammed to the crusher bins and after passing through the large gyratory breakers is carried past more pickers. A minimum number of cars of waste is set as a limit and a maximum value is also fixed for the rock that is sorted out; as the sorters are paid a bonus on all cars of waste rock that is sorted out in excess of this limit, this system works well, and the unusual sight is presented of ore-pickers working fast themselves, and attending to it that their companions do the same. They even pick waste between bites of lunch, or while rolling a cigarette.

The plant of the Guanajuato Amalgamated Company, at La Luz, is the only one in the district that is equipped with a separate sampling plant. It consists of large and small gyratory breakers with samplers which take out a definite proportion of the stone and reduce it to convenient quantity and mesh. The Reduction company has arranged an intermittent sampler under the discharge from the belt which brings the ore to the mill, and it is difficult to see why this sample should not be as accurate as such samples can be. At the San Prospero mill, since almost all the ores treated are custom ores, the ore is sampled by hand at the city office and at the various mines and dumps before it is sent to the mill. Sometimes this sampling is done on the large stone *patio* above the mill.

Pinguico Mill

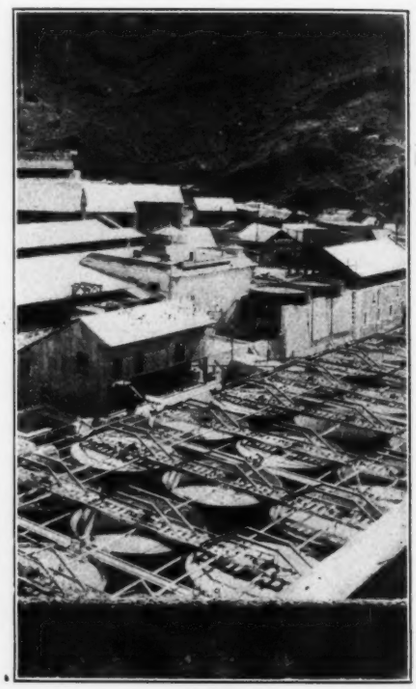
Although the gyratory breaker is the favorite, where it is possible to use it, at the Pinguico mill, a new plant which has just been completed, Blake crushers are used mainly owing to the wet and sticky condition of the ore that is treated. It is almost impossible to pass this material through a grizzly and still more difficult to force it through a gyratory breaker. The engineer in charge of the design of the plant, J. B. Empson, expected to have even a larger proportion of this mud than is at present produced. During the construction of the mill the harder rock now being treated, was developed in the mine, but by judicious modifications the mill has been adapted to the varying character of ore.

The ore is brought from the mine in cars, at present drawn by mules, but power is soon to be used for this purpose. The cars dump onto a grizzly but, although the grizzlies are large and ample, owing to its stickiness the ore has to be scraped through the bars. The oversize is shoveled to two Blake breakers and this crushed rock then rejoins the undersize which is fed to the stamps, 40 in number, which at present are crushing through an 8-mesh screen.

The pulp from the stamp mills is roughly separated into two sizes in a classifying launder. The coarse sizes go to two Chilean mills using 40-mesh screens. Then it rejoins the undersize from the launder and is classified by a "V" box classifier, 20 ft. long x 5 ft. high, whose sides slope 60 deg., into different sizes, which feed to different ones of the 12 Wilfley tables treating this product.

The middling from these tables goes to a Bryan mill to be re-ground before being re-concentrated on four Wilfley tables. The slime and tailing from all the Wilfley tables then is sent to two Dorr classifiers which separate the pulp into slime and sand. The slime goes to the cement table, an immense *planilla*, which separates a fine concentrate from the slime pulp before the slime goes to the slime plant, in which it is cyanided, a vacuum filter being used. The sand from the Dorr classifier goes direct to the sand plant for cyanide treatment.

The Dorr classifiers are said to be overloaded but, if one may judge from the condition of the sand sent to the leaching tanks, they are doing excellent work. To give a better idea of this excellence it may be stated that a Butters-Means distributer was provided for loading the tanks but is not used; instead, the sand, after the solution has been added, drops to the center of the 30-ft. vats. This sand from the Dorr classifiers is so clean that it is possible to walk anywhere in the tank while it is filling, and yet the overflow will remain almost clear. In fact, the overflow is pumped directly to the battery supply tank without previous settlement or clarification.



SLIMES TANKS, LORETA MILL, PACHUCA

A Dorr classifier is used at a plant in Durango to feed sand to a tube mill and is working very successfully. Although it is usually said that the pulp fed to the tube mills is "about one to one," it is extremely difficult to get such a feed from a system of cone classifiers. The discharge from a Dorr classifier is much less than one to one, consequently, solution or water may be added to bring the pulp to exactly the right consistency. With the Dorr classifier there is no choking or overflowing, and a slight change in the quantity of pulp coming from the battery or rolls, does not change the feed to the tube mill.

Owing to the double concentration and good classification, the sands are in fine

condition for leaching. The sand tanks fill in about 24 hours, and, as there are 12 sand tanks, the time of treatment is from 10 to 12 days. As the plant has just started, the sequence and strengths of solutions used is changed from time to time so an exact statement of the practice cannot be given. The size of the screen opening is also being changed from time to time. It has been decided that, although the sand is perfectly clean of slime, it will pay to turn the charge during treatment. Owing to the good condition of this sand, it seems improbable that shoveling of the charge assists extraction by breaking up channels that form in the pulp during leaching, but rather that the increased extraction is due entirely to the exposure of the sand to air.

It would seem that a blower having large displacement under low pressure with its suction attached below the filter bottom would accomplish a much greater oxidation in a shorter period than mechanical handling. But a blower could only be expected to give good aëration with clean sand, for at the ordinary plant a pump can draw 8 or 10 in. of vacuum, some time after all the solution has drained off that will.

Concentrating the Slime at the Pinguico Mill

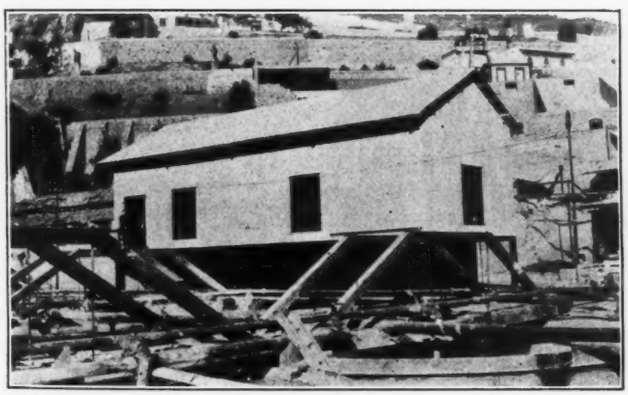
The question of slime concentration is being given much attention, and probably the Pinguico mill has the most extensive table for this work so far built in Mexico. Instead of being made of canvas, the table is merely a slightly inclined floor of cement, 30 ft. long (in the direction of the flow of pulp) and 180 ft. wide. The surface of the table is roughened and is divided into strakes 6 ft. wide; the slime pulp is divided so that each strake receives its proper proportion. The concentrate made on this large *planilla*, is washed periodically into a launder leading to a Johnson vanner on which it is re-concentrated. Two men per shift, at $0.37 per day each are required to collect the concentrate caught here. This fine concentrate is of higher grade than the concentrate caught on the Wilfley tables, and well repays the cost and trouble of the concentration. Removing this mineral from the slime serves the two-fold purpose of reducing the value of the slime, and of leaving it in a much better condition for cyaniding.

The slime is collected in three 30-ft. tanks, from which it is continuously drawn to each of the 12 treatment tanks which are used in turn. The pulp in these tanks is agitated by compressed air at a much lower cost than if mechanical agitation were used. The charging of a tank with 40 tons of slime requires about 12 hours so that the time of treatment is five days.

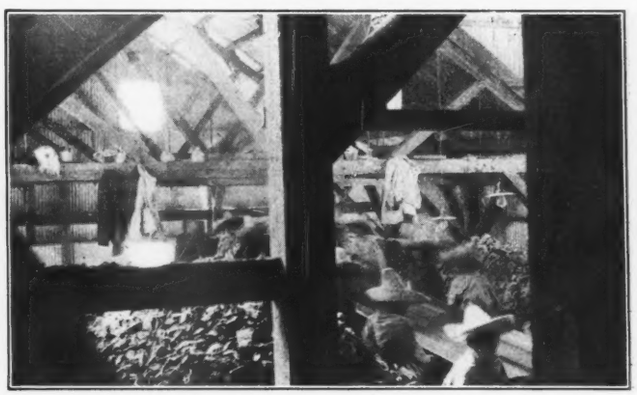
The apparently excessive tank capacity is the point mentioned most frequently by metallurgists visiting Mexico who are accustomed to gold-ore treatment. But it should be remembered that slime from silver ore is given a treatment varying from 25 to 150 hours, not including the time of contact with solution from battery to slime plant. This should be compared with the maximum of two or three hours required in some plants treating slime from gold ore, or with results obtained by C. W. Merrill, at whose plant in Deadwood, S. D., the slime is in actual contact with solution less time, probably, than in any other plant that obtains a high extraction.

SORTING ORE AT NIEVES, ZACATECAS

WASTE DUMP BEING MILLED BY THE GUANAJUATO REDUCTION AND MINES COMPANY



A 200-TON BUTTERS FILTER



SORTING ORE AT THE MILL OF THE GUANAJUATO REDUCTION AND MINES COMPANY

This large tank room at the Pinguico mill permits of several washes being applied to the slime before transferring it to the vacuum filter, although it is planned to send the pulp directly from the treatment tanks to the filter. The proportion of sand to slime is about as 60 to 40; the slime is very amenable to vacuum filtration, for a sufficiently heavy cake of slime forms on the filter leaves in 30 minutes.

The filter plant follows what is called a semi-gravity arrangement, the box filling by gravity through a 10-in. pipe and the surplus returning through a 6-in. centrifugal pump. The mill is built well above the creek so that the sand and slime can be carried away by water. The data on

filtration when available will be exceedingly interesting.

The capacity of the sand tanks is also ample at this plant, for there are 12 tanks holding 115 tons of dry sand; it takes about 24 hours to fill a tank. Under the two rows of sand tanks are lines of conveyer belts to which the sand is shoveled after treatment. The tanks are discharged by four natives in from 6 to 8 hours for a contract price of 4.50 *pesos*, or nearly $0.02 gold per ton. The cost of turning the sand over during treatment is slightly less.

This plant has been running about a month and is said to be obtaining a good extraction from high-grade silver ore. Experiments are now being made to determine the possibility of cyaniding all the concentrates from the mill. A small tube mill has been arranged to grind the concentrate to a fine pulp. This pulp is then agitated with strong solution in a Brown tank using air for agitation. Similar experiments were made by Joseph MacDonald, of the Consolidated Company, some time ago, and, although the results were not published the smelter charges for this material were much reduced so that, whether the material can be cyanided or not, the practical results of the experiments were eminently satisfactory.

Guanajuato Reduction and Mines Company

This plant under the management of C. W. Van Law has grown to 160 stamps, and treats 500 tons of ore per day. The ore is sorted before and after crushing. After being stamped through a 26-mesh screen, it is transported about a mile through a cast-iron pipe laid on a 2¼-in. grade. This line has been described recently by Mr. Van Law. The pulp after reaching the cyanide plant, is separated by cone classifiers into sand and slime.

The sand tanks are filled and discharged by means of conveyer belts. The slime is agitated mechanically and is given several baths of solution, of which mention will be made later. Milling is done in solution containing 0.03 to 0.05 per cent. cyanide in the proportion of about 10 of solution to one of ore.

About half this solution is removed by a set of cone classifiers below the mill; the balance serves to transport the ore to the cyanide plant. After the extraction is obtained from the slime, it is transferred to settling tanks and drawn, as needed, to the vacuum slime filter, whence it is discharged to the river. This plant is working on the lowest grade of ore treated in Guanajuato and is said to be paying well even at the present low price of silver.

The tube-mill practice at this plant is especially interesting and has been recently described in the *Mining and Scientific Press*. The tube-mills are of the Abbé tire type and have run without a hitch since their installation.

Re-grinding

It is the consensus of opinion in Guanajuato, Pachuca and El Oro that fine-grinding is necessary in order to obtain a good extraction from silver ores, and the tube mill is considered best for this fine-grinding. Chilean mills have been tried at Pachuca but have not been satisfactory for re-grinding, although exceedingly good results are attained at the Hacienda La Union, using a feed larger than one inch in size and an overflow discharge.

Additional tube mills are to be placed in the Perigrina mill, Loreto and Guerrero mills of the Compañia Real del Monte y Pachuca, and at the mill of the Guanajuato Consolidated Company. The fine sand from the ores of Guanajuato stays in suspension and makes a good pulp for treatment on vacuum filters.

Three large plants equipped with Butters filter have recently started and a Ridgway filter is being tried by the Guanajuato Consolidated Company, as an experiment, it being the first Ridgway filter used in Mexico. Results are awaited with much interest.

Perigrina Mill

The Perigrina mill, now operating 100 stamps under the management of J. James Hollister, is crushing more than four tons per stamp through 30-mesh screens. The product from the stamps goes to Wilfley tables, the sands being re-ground in tube mills. The material separated by classifiers from the tube-mill pulp goes to sand-leaching tanks; the overflow joins the slime in the settling tanks.

The sand is collected in two tanks, from which it is excavated and transferred to leaching tanks by a system of Blaisdell machinery. The product from this mill is 56 per cent. slime for which the present treatment tanks are not adequate, considering the increased tonnage. When the projected additions of tube-mill capacity are made the slime plant will be crowded still further.

The sand is handled cheaply by the Blaisdell system, it being stated that the cost of discharging a tank of about 120 tons is under 2.50 *pesos*, or 1¼ c. gold per ton. The ore is crushed in solution; the strength of the solution used in the battery being about 0.05 per cent. cyanide.

San Prospero Mill

This plant does most of the custom work of the camp. It consists of 40 stamps, Wilfley tables, a cement slime table, tube mill, with sand and slime plant. The sand plant is equipped with Blaisdell machinery. The tanks for agitating the slimes are furnished with a slowly moving agitator provided with numerous air jets. This agitator has been replaced in other plants under the same management, and probably it will be removed here, for the agitation does not compare favorably with the agitation obtained in a Brown tank, or even with ordinary mechanical agitation, although the power cost is less than that of the latter.

The mixture of ores which have to be treated by C. E. Rhodes at this mill require such constant changes in procedure that no routine of treatment can be arranged.

At one time the slime will settle beautifully to a specific gravity of 1.2, but at other times the specific gravity increases to 1.07 so that the treatment of these various pulps must vary. The tank room, for treating slimes in view of this variation, is entirely inadequate, and a slime filter has been added.

THE MILL AT LA LUZ, BELONGING TO THE GUANAJUATO AMALGAMATED GOLD MINES COMPANY

Cement storage tanks are being built to provide for more settlement and the slime, without washing will be drawn to these settling tanks, decanted as much as possible, and filtered and washed in the 60-leaf vacuum filter.

Pastitas

The 80-stamp mill, of the Guanajuato Consolidated Company, is treating the high-grade ore of the Serena mine and doing good work. The stamps crush fine, the tube mill not being in running order yet. The pulp from the stamps goes to Wilfley and new Standard tables. The finer part of the ore goes over Frue vanners after passing the tables.

The slime is settled in a series of concrete vats whence it is elevated and taken in launders to the slime agitating tanks. These are equipped with the ordinary mechanical agitators and are ample in number for good extraction.

Sands are collected in a very small tank which has the constant attention of a native, who with a stream of water washes to the discharge slots any slime which seems inclined to stay with the sand. This sand is in excellent condition for leaching. The sand is sluiced out from these tanks to the foot of a bucket elevator, which raises the pulp to a launder discharging into the river.

The slime is agitated mechanically and pumped to storage and settling tanks. From these it is discharged to the river. A Ridgway filter is under construction at this plant and is about ready to run. While not of sufficient capacity to handle the entire slime output, this unit is to be supplemented by others, provided that it proves successful.

Jesus Maria

The mill built by the Guanajuato Amalgamated Company, near La Luz, consists of a complete crushing and sampling plant, 100 stamps, concentrators, with a cyanide plant for treating sand and slime. The mill was designed and built by V. B. Sherrod and is a model of workmanship and arrangement.

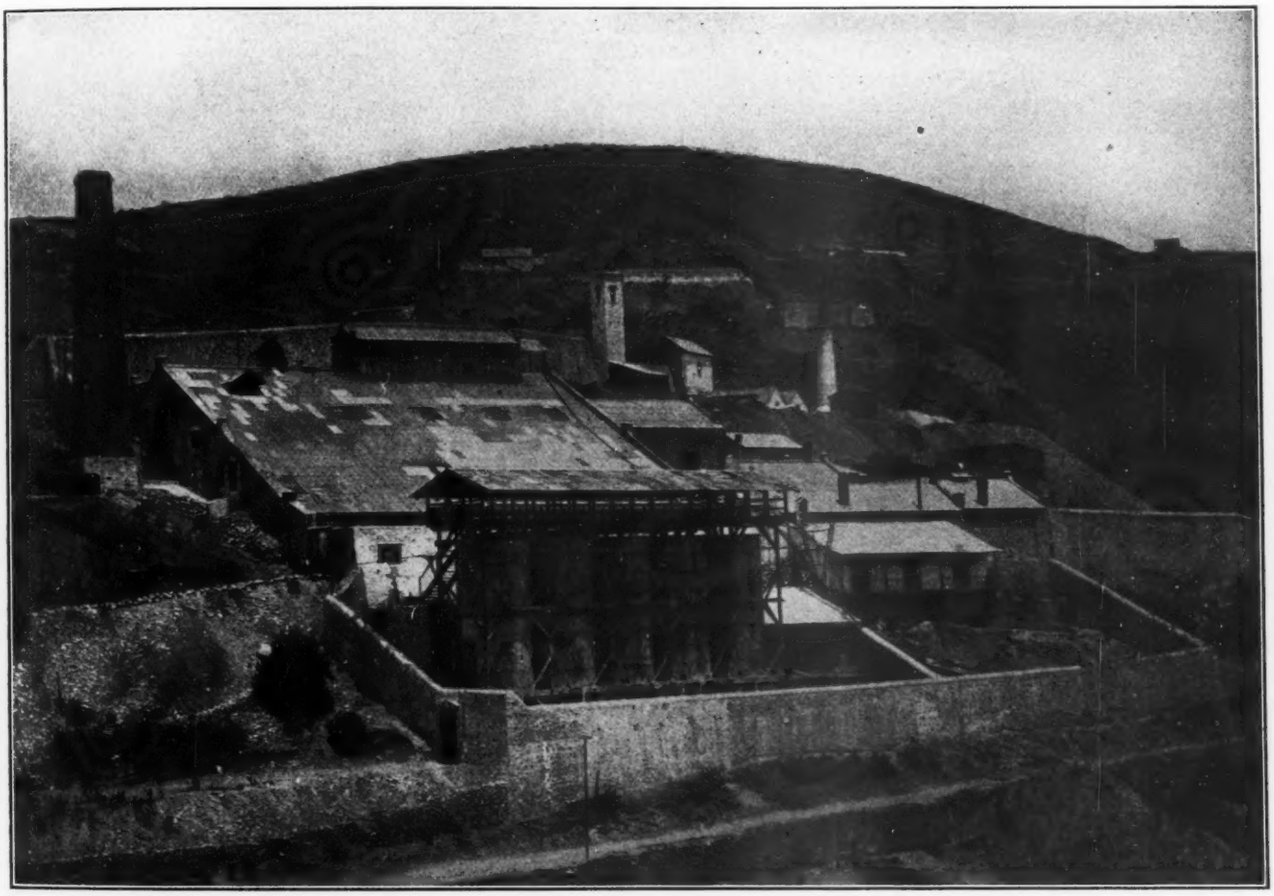
The pulp, as it is classified before going to the Wilfley tables, is in good condition for concentration, and the ore lends itself to this treatment for the gangue is comparatively light and the mineral very heavy.

At present this mill uses water in the battery, but the plan of milling in solution and adding a slime filter is being considered. As a considerable proportion of the gold is caught on plates, it would be necessary to make an additional saving in the concentrate and in cyaniding. The gold in the ore is all exceedingly fine.

Air agitation of slime gives good treatment and mixing, though the addition of a central tube would probably reduce the power cost. This central tube for slime treatment is covered by patent in Mexico by W. J Lavington and was first placed in operation in Pachuca by A. Grothe.

The Brown Agitating Vats Used at Pachuca

The practice in really good air agitation is confined to the plant erected by Mr. Grothe at Pachuca, and in his plant he followed closely the practice of F. G. Brown of Waihi, New Zealand.



HACIENDA DE SAN FRANCISCO, SHOWING THE BROWN AGITATING TANKS IN THE FOREGROUND

The plant consists of five tall tanks, 40 ft. high by 15 ft. diameter. A central pipe of large diameter reaches nearly to the top and nearly to the bottom of the tank. When the charge is ready for treatment, air is turned into the bottom of this pipe, and in a short time the entire charge is in agitation. The tank is provided with a conical bottom, so that the sand as it strikes the bottom slides to the point of the cone and is drawn into the central tube and again discharged.

It is a question at present, just how much air should be used for a tank of this size. The determining factors will be fineness of pulp, strength of solution, dilution of pulp, grade of ore and power cost, but with all these points decided, it

will be difficult to ascertain just how much extraction is helped by varying the quantity of air used.

Mr. Grothe agitated 100 tons of mixed sand and slime with 6 h.p. and the agitation seems all that could be desired. At the same time, in a recent letter, Mr. Brown writes from New Zealand, that he is agitating 35 to 40 tons of fine concentrates with ¾ h.p.; this seems almost incredible. The tank that he uses is 37 ft. high and 7 ft. 6 in. diameter. He reports that the agitation is perfect and that extraction reaches 94 per cent. on concentrates worth £20 per ton.

His experience seems to demand very narrow tanks, as the eight new tanks, being built to treat the battery pulp direct from the stamps, are 13 ft. diameter by 55 ft. high. Mr. Grothe thinks that in order to obtain the most perfect air agitation in such a tank, just enough air should be used to keep the cone bottom of the tank clear, and that, if an increase in altitude or decrease of diameter will reduce air consumption, these changes should be made.

A variation of the Brown tank, described by Mr. Crosse, consists in discharging the pulp through pipes tangentially, thus forcing the pulp into circular motion. This requires the lifting of the pulp two feet above the level in the tank, which will require more power. The circular motion, however, will probably greatly assist in preventing the sand from stopping on the cone bottom; and, with a proportionately smaller central pipe, the same quantity of air may give a better agitation, if discharged this way.

Repairs are nothing on such tanks and attention almost nothing, and where power is cheap or water is available for compressing air, agitation by this method would cost very little indeed.

At one plant in Mexico where water is under about 100-ft. pressure the air will be compressed by entraining the air at the intake of a pipe leading to a pressure tank below. Instead of returning the discharge water to nearly the hight of entry, the water will be discharged through a float valve. The first cost of such a plant will be low and the cost of upkeep small.

Pachuca

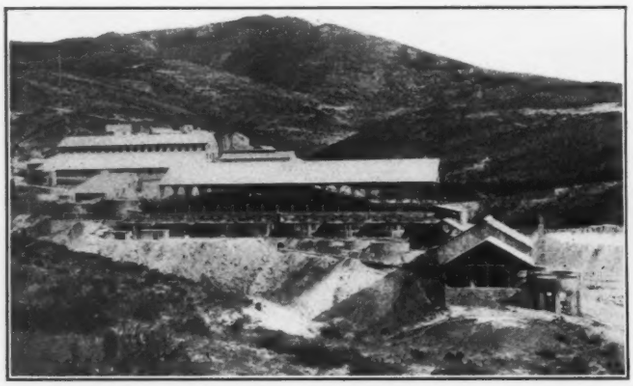
The Blaisdell Coscotitlan Syndicate is building at Pachuca, a plant to treat the immense dumps of tailings that have accumulated from the treatment of silver ores in the various *patio haciendas* there. This tailing pile is estimated to contain anywhere from 600,000 to 1,600,000 tons according to the percentage of rock that it is assumed can be worked profitably. Probably the deepest part of the sand will not exceed 10 ft., while a very large part is spread over an enormous area, requiring much trouble and expense to collect it. Considerable organic matter is contained in the tailing, part of which will be taken out with Callow screens, though what remains will cause a large consumption of cyanide. However, all the disadvantages are covered by the assay value of the material, it being worth very nearly $5 gold per ton, and by Mr. Blaisdell's being the moving spirit of the company.

There is little information obtainable as to method of treatment to be adopted, probably on account of the uncertainty as to how the material will act when a large tonnage is treated. It is said in Pachuca, however, that the slime will be treated by the Adair-Usher patented process (U. S. Patent No. 860,775).

The Adair-Usher process consists of filling the slime-treatment tanks with pulp through a central pipe reaching to the bottom, from which branches extend in order to distribute the pulp gently and evenly. The cyanide solution then is added through this pipe system, and later the wash water, the solution or water, which enters with the pulp as well as the treating solution being in turn displaced and overflowing at the rim. The slime is supposed to stay in suspension and neither settle nor overflow.

The tanks for a 500-ton plant are now erected and pumps and piping are being placed. Space is provided for tube mills, should this addition be found desirable. The sand will be brought to the plant in cars and dumped upon a conveyer belt by which it will be transferred to a pulping tank. From this the pulp will go to Callow screens and to the collecting tanks. This Adair-Usher process is much discussed at Pachuca and the outcome at Cuescos will be interesting to many.

Francisco Narvaez of the Hacienda La Union and Edmond Girault of the San Rafael mine have each contracted for cyanide plants, intending to fine-grind the entire mill pulp and to agitate it with air in "Pachuca" (Brown) tanks. These plants will replace the patio treatment of the ores, and are largely due to the results attained by Mr. Grothe at the Hacienda de San Francisco. This latter plant has air-agitation tanks, five in number, for treating the entire mill pulp by air agitation, followed by filtration on a vacuum filter. Besides the regular treatment of custom ores which is carried on at all times, this plant has been in the hands of such men as Mr. Narvaez and Mr. Empson for short tests and has shown excellent results.



PERIGRINA MILL, GUANAJUATO

PINGUICO MILL, GUANAJUATO

By far the largest plant in Pachuca is the Loreto mill of the Compañia de Real del Monte y Pachuca. Briefly, this plant consists of 40 stamps, Wilfley tables, Chilean mills for re-grinding, Frue vanners and agitating tanks for cyaniding the tailing. The metallurgy of this company is now in charge of V. B. Sherrod, who is adding tube mills and a Butters filter. At present the pulp is washed by decantation. Mr. Sherrod is also building the Guerrero mill for the same company. Tube mills and a Butters filter will be used in this mill also. As originally designed the 40 stamps were to be followed by re-grinding mills in Chilean design, concentration and agitation of the tailing with cyanide.

Precipitation

With the exception of some of the plants operated by Charles Butters where

electrical precipitation is used, zinc is preferred for precipitation, and with very few exceptions perhaps not more than two, zinc shavings are used. The reason for this preference for zinc shavings lies partly in inexperience and partly in cost. Figures from one of the most economically operated plants in the United States using dust show that the ratio of zinc to bullion is more than 40 to 1 while in El Oro the ratio of zinc shavings to bullion varies between 6 and 10 to one.

But against this greater consumption of zinc should be set the extra expense of clean-up when shavings are used, compared to the cost when the precipitation is done with zinc dust. Although shavings have the advantage at present, it does not follow that this method is perfect, and when a company consumes 600 pounds per day of zinc, there certainly seems to be room for the experimenter.

There is a field here for electrical precipitation, followed perhaps by precipitation of the tail solutions on zinc. This would greatly decrease the cost of clean-up and of zinc, and give a better grade of bullion.

Solution which has passed through the zinc boxes is supposed to have greater dissolving power than that which has been for some time in contact with ore. For this reason some of the largest operators claim that better extraction is obtained in a given time by alternately settling, decanting and adding new solution, than by one continuous agitation with one solution. This is, however, still a mooted question, the difference in extraction being slight and not observable in all experiments.

The solution is supposed to gain or lose something in its journey through the zinc boxes, which gives it increased dissolving power; but, if the latter is the case, the solutions would be much freer from the baser metals after electrical precipitation than after zinc precipitation. A difficulty in this process, heretofore, has been the cost and destruction of the lead anodes, but the advent on the market of dense, pure graphite and of the metallic-oxide anode, recently invented by R. J. Wisnom, will go far toward eliminating these disadvantages.

Aeration of Solutions

The plants generally provide some method of aëration for the solutions, great pains being taken in some instances to spray the solution into the storage tanks. The value of this aëration, or the actual change effected in the solution seems not to be exactly understood. At one plant, where a very uniform grade and class of ore is treated, the percentage of extraction of the gold and silver varies exceedingly, at times the extraction of silver being greater than that of the gold. No explanation of this has as yet been proved to be correct, although careful chemical analyses have been made of solution, ore and precipitate.

In tube milling, silex lining is gradually being replaced with the Brown, or El Oro type of chilled cast-iron liner, which is proving much cheaper than anything used so far in this country.

Practice at El Oro has changed little since the very complete paper by Messrs. Burt and Caetani was read before the American Institution of Mining Engineers. The Mexico mill has started recently and will have some valuable data on crushnig in tube mills, particularly on coarse-crushing. Burt filters will be used for filtering the entire mill product. The practice at the Dos Estrellas mill nearly approximates that at El Oro, though on account of large tank capacity, the plant is in a better position to make good extraction.

The Esperanza Company, contemplates re-grinding its large sand dump with subsequent leaching or filtering as may prove best. Meantime a vacuum filter is being built to filter the slime now being treated.

Of the other plants throughout the Republic, the one being built by Robert R. Allen for the Veta Colorada company at Minas Nuevas is interesting. As originally designed the plant consisted of sand and slime-treatment tanks, but Mr. Allen, who is just from West Australia, has elimited the sand-treatment plant, and added a series of tube mills, the total mill pulp to be filtered on Ridgway filters. The 80 stamps will crush about 400 tons per day.

This will be the first cyanide plant in the Parral district and will be followed by others if successful, as the district can produce a large tonnage of milling ore.

Bert Peterson, operating the mill and mine at Los Azules for the El Rayo Mining and Development Company, near Santa Barbara, has remodeled an old mill and introduced several new features, among them being a Merrill slime filter and a Merrill zinc-dust precipitation system. With both of these he is highly pleased.

There are many other plants under construction, most of which are displacing sand treatment with tube-milling and vacuum filtration, but a mere enumeration of them with a statement of what they intend to do would have little interest. During the present year much valuable information will be obtained regarding the cyaniding of silver ores.

Zinc mining in Mexico has become important only in the last three years. The most important zinc deposits are near Monterrey. At Calera there is a large amount of mixed-sulphide ore while the Tiro General in San Luis Potosi is also producing zinc ore.

Black Mountain Mining Company

The plant of the Black Mountain Mining Company, at the Cerro Prieto mines, 26 miles southeast of Magdalena, Sonora, Mexico, began operations March 12. The entire plant is operated by electric current generated at Magdalena by steam turbine engines. The plant handled during the first week about 500 tons of ore daily and the gross bullion returns for the month will be approximately $60,000. The first tube mill went into commission March 15 and six additional mills are to be started up as required. The tonnage is expected to be increased 50 per cent. within a short time. The January tonnage was 12,830, and that of February 12,056 tons.

Costs of operation are being lowered gradually; $2.50 per ton, or somewhat less, is the figure the management hopes to reach. The principal factors for this reduction are: The use of machine drills in stoping; better communications in the mine; increase in mill tonnage by the use of tube mills. The effect of finer grinding will be a 10-per cent. higher extraction from the sands. The extra washing of the slimes in the filter box will make nearly the same saving. The sands represent about 60 per cent. of the total tonnage.

According to information communicated by an officer of the company, the average assay of the ore milled is somewhat more than $5; the first 12 days in March showed $4.40 in gold and nearly $1 in silver. The recovery under the improved changes will be more than 90 per cent., or not less than $4.50 per ton. With March, expenditures on construction and equipment beyond unimportant items came to an end for the present. The equipment of the property cost about $2,000,000.

Mine Inspection in Mexico

A law to make mineowners responsible for loss of life and injury by accidents in Mexico is under consideration by Sr. Olegario Molina, minister of *fomento,* and will probably be submitted to congress soon. The moving cause for this action is found in the recent explosions in the coal mines at La Esperanza and La Rosita, in which a number of lives were lost. Government engineers have been investigating the causes of those accidents; in the case of the La Esperanza a report has already been submitted.

The terms of the proposed law have not yet been made public, but it is understood that provision will be made for inspection of mines, either by special commissions, or by a body of inspectors to be appointed.

The Spaniards began to mine silver ore at Zacatecas, Mexico in 1540.

Cyanidation of Silver Ores at Guanajuato

The Pioneer Plant of the District Employs Only Stamps for Crushing, Long Treatment of Pulp, Percolation, Decantation and Precipitation

BY BERNARD MACDONALD*

All silver ores are not amenable to cyanide treatment; therefore, the character of the vein and of the ore and the methods used in preparing the ore for cyanidation at the Hacienda de San Francisco, Guanajuato, Mex., will be described.

The Sirena mine contains 3300 ft. along the outcrop of the Veta Madre, or mother vein of Guanajuato, and 1995 ft. over the dip of the vein.

The Veta Madre is an immense vein occupying a fault fissure; it has a north-west-southeast strike, and dips 45 deg. to the southwest; in width it varies from 60 to 300 ft. The gangue or vein matter consists of quartz, some calcite and brecciated country rock, the whole mass being cemented together with silica and impregnated with pyrrhotite and iron pyrites.

Near the orebodies, the vein matter is disseminated with the sulphides of silver, argentite, stephanite and pyrargyrite. Associated or combined with the silver sulphides is a small percentage of gold, amounting to five-thousandths of the weight of the silver, or about 15 per cent. of the value of the ore.

The grade of the orebodies taken as a whole is low, averaging 450 grams (14 oz.) silver and 2.4 grams gold, per ton.

The analysis of the milling ore shows it to consist of 85 per cent. insoluble, 6 per cent iron, 2.5 per cent. sulphur, 2 per cent. lime. The quartz vein-matter, except that near the orebodies containing silver sulphide disseminated through it, does not carry an appreciable amount of gold or silver. It has been determined also that the iron pyrites mixed in the ore does not carry the precious metals. The ore milled comes from the vein at depths ranging from 800 to 1000 ft. vertically below its outcrop and shows signs of oxidation.

The Crushing, the Sorting and the Transportation of the Ore Before it Reaches the Mill

The ore coming from the mine is dumped into the storage bins. From the chutes of these bins two crushermen allow the ore to feed by gravity into the jaws of two Blake breakers, placed in a pit dug below the level of the mine *patio* or yard. The ore is crushed to pass a 2-in. ring and falls into the boot of a bucket elevator, which delivers the ore to a grizzly in the sorting room. The grizzly bars are set ½ in. apart; this allows the ore, too fine to be sorted, to fall through to the fine-ore bin underneath. The ore, too coarse to pass through and suitable for handpicking, slides down the grizzly upon a traveling picking belt. This belt

SLIME TANKS IN FOREGROUND, MILL IN BACKGROUND, GUANAJUATO CONSOLIDATED MINING AND MILLING COMPANY

Note—This article, as received from the author, included an extremely interesting history of the development of the metallurgy of silver in Mexico, beginning with the patio process and tracing the various steps to the present cyanide treatment. This historical portion has been crowded out of the present issue by lack of space; it will appear in a future number of the JOURNAL.

*Mining engineer, Guanajuato Consolidated Mining and Milling Company, Guanajuato, Mexico.

consists of loose-jointed steel slats, 30 in. wide, and travels at a speed of 40 ft. per minute. On either side of this belt the ore sorters pick off the waste and low-grade ore, dropping it into the bins beneath the floor, while the belt carries the sorted ore into the coarse-ore bins at the end.

About 10,000 tons of ore is mined each month, of which about 20 per cent., or 2000 tons, is sorted out as waste and hauled to the dump, while the remaining 8000 tons is hauled to the mill for treatment.

The ore is hauled from the mine shafts to the crushing and sorting house, and the waste from there to the dump and the ore to the mill by two 15-h.p. Westinghouse electric locomotives in trains of ten cars, each of which holds two tons of ore.

COST OF HANDLING ORE FROM MINE TO MILL.

Sorting and Hauling Ore to Mill and Waste to Dump.	
Monthly tonnage run-of-mine ore	10,000 tons.
Waste sorted out	2,000 tons.
Tonnage to mill	8,000 tons.
Distance from mine shafts to mine yard, 3,000-4,000 ft.	
Distance between mine yard and mill, 2,800 ft.	
Crushing and Sorting per Ton Sorted Ore.	
Labor	$0.0873
Power	0.0253
Repairs and supplies	0.0364
Total	$0.1490
Haulage, Ore to Mill and Waste to Dump	
Labor	$0.0068
Power	0.0050
Repairs and supplies	0.0040
Total	$0.0158. $0.1648

At the mill, the ore is dumped into the storage bins and mixed with an amount of commercial burnt lime equivalent to 10 kg. of CaO (pure lime) per ton, as this is the average amount of lime required to neutralize the free sulphuric acid in the pulp and to furnish the protective alkalinity required for the cyanide solutions, which are added in the subsequent treatment of the pulp.

Crushing

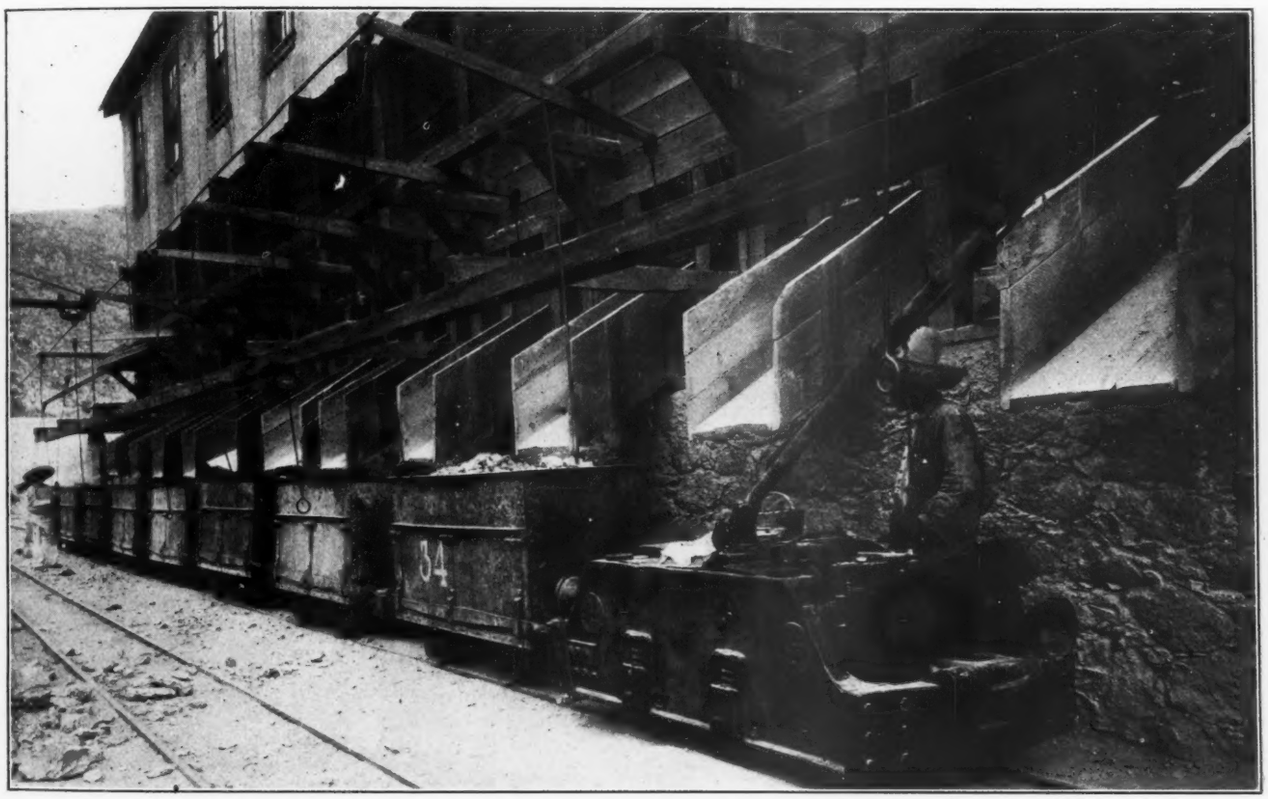
The ore then goes to the 80 stamps for finer crushing. The stamps weigh 1050 lb. each, drop 7½ in., 104 times per minute, and are placed in batteries of five. The mortars are of the heavy El Oro type, weighing 9000 lb. each, and are bolted to concrete foundations with a rubber sheet, ¼ in. thick, intervening. The mill is operated by electric power throughout; this electric power costs about $80 per horse-power per annum.

The stamps are run by four 30-h.p. motors, and two 50-h.p. motors. The smaller motors each run 10 stamps and the larger motors each run 20 stamps.

From the storage bins the ore is fed automatically by Challenge feeders into the mortars, where 7.2 times its own weight of water is added; this, being really precipitated solution returned from the cyanide plant, contains 0.025 per cent. of KCN, or ½ lb. per ton of water. The ore is crushed in the mortars to a fineness which allows it to flow through 50-mesh screens. No additional re-grinding machinery is used. The efficiency, economy and simplicity of this crushing is such that it will compare favorably with plants using re-grinding machinery.

The battery screens used are Harrington & King's No. 10 diagonal slot screen; the slots are 0.018 in. wide, 17/32 in. long, approximating 50-mesh wire cloth. These screens have a life of 30 to 35 days. The stamp duty pulping through these screens is 3.3 metric tons per 24 hours, or 5 lb. of ore per stamp per minute.

Joseph MacDonald, the manager for the company, considers that the low stamp duty is due largely to the fine battery screens used and to some extent to the inefficiency of native labor. As bearing out this statement he says that, while he was manager of the Treadwell mine in Alaska, the average duty per stamp in the 300-stamp mill at that mine, with 1050-lb. stamps crushing through 30-mesh screens, was 5½ short tons per day—and in the 240-stamp mill of the same mine, crushing with 850-lb. stamps through 30-mesh screens, the average duty per stamp was 4½ tons per day. But when considering the duty per stamp one must remember that in the case of the 50-mesh screens used in this mill, there is the equivalent of 2500 holes to the square inch, through which all the pulp must flow, as against 900 holes for the 30-mesh screens.



CRUSHING AND SORTING HOUSE, WITH TRAIN LOADING FROM BIN. GUANAJUATO CONSOLIDATED MINING AND MILLING COMPANY

SCREEN DETERMINATIONS OF BATTERY PULP.

Mesh.	Percentage of Weight.		Percentage of Value.	
Through 40	0.89		0.26	
Through 40 — 50	2.71		1.12	
Through 50 — 60	6.92		3.26	
Through 60 — 80	10.71		6.62	
Through 80 — 100	0.34		0.12	
		21.57		11.38
Through 100 — 120	10.41		11.32	
Through 120 — 150	7.65		10.12	
Through 150 — 200	1.72		1.27	
		19.78		22.71
Through 200		57.65		63.86
Lost in dusting		1.00		2.05

The percentage of value remaining on the different meshes was carefully calculated from the assay of the pulp remaining on each screen. The percentages show that in crushing this ore the richest portion of the ore is friable and goes to the smaller sizes, and remains with the finer classifications of the pulp, for from the table it will be seen that while 21.57 per cent. of the pulp was too coarse to pass the 100-mesh screen, still this portion represented only 11.38 per cent. of the total value of the sample; that is the assay value of this portion was only about one-half that of the original ore. It will also be seen that 78.43 per cent. of the weight (by difference) passed through the 100-mesh screen, and that this represented 88.62 per cent. of the total value of the sample, while 57.65 per cent. that passed through the 200-mesh screen represented 63.86 per cent. It is assumed that the 1 per cent. of the weight unaccounted for was lost by dusting and that this quantity represented the 2 per cent. of the value of the original sample unaccounted for in the total. In plant treatment, of course, the amount lost would go with the slime.

Concentrating the Pulp

The pulp from the stamps is concentrated on 12 No. 3 Wilfley tables, 4 Standard tables and 13 Frue vanners. On passing through the battery screens, the pulp from each mortar flows into a double-compartment spitzkasten, each compartment being 22x22x22 ft. The discharge from the bottom of each spitzkasten is regulated, so that a part of the water, amounting to about 12 per cent. of the total water in the pulp, and some of the finest slime overflows from the last compartment. The pulp flowing from the bottom discharge of the two compartments feeds to one Wilfley table, and the overflow from the last compartment goes to the slime-settling tanks. This separation of a part of the water and fine slime from the battery pulp has a favorable effect on the concentration, in that some of the finest particles of silver sulphide are saved as concentrate, that would, with the heavier flow of water and slime, be swept off the table with the tailing.

The concentrate made by the Wilfleys flows through pipes to the storage tanks in the concentrate room, and the slime overflow from the last five feet of the Wilfley tailboard is cut off and sent to the slime-settling tanks, while the remainder of the Wilfley tailing goes direct to the Frue vanners.

The concentrate made by the vanners is also piped to the storage tanks in the concentrate room, where it mixes with the Wilfley concentrate. Together these two concentrates make up 2½ per cent. of the weight of the crude ore and contain about 50 per cent. of its value.

The accompanying table, showing the cost of crushing (pulping the ore), includes the cost of concentration, caring for the water-supply ditches, pumping back the returned water and elevating the sand classification.

COST OF CRUSHING AND CONCENTRATING PER TON.

Labor, including machine, smith and carpenter work	$0.26
Supplies, including machine, smith and carpenter shop	0.20
Electric power	0.52
Assaying	0.03
Proportion of general office expense	0.03
Hacienda expense	0.05
Insurance	0.01
Total	$1.10

The concentrate, containing an average of 42 per cent. iron and 6 per cent. silica, is sold to the smelters under a favorable contract. The company, however, is planning to erect a small cyanide plant for the treatment of the concentrate, as a large number of tests have shown that it can be advantageously treated by that method. An article showing the result of the original tests made on the cyanidation of these concentrates appeared in this JOURNAL, Dec. 23 and 30, 1905.

The tailings from the vanners and the slimes, which together amount to 97½ per cent. of the weight of the crude ore and contain approximately 50 per cent. of its value, are cyanided.

Classification

The system of cyanidation employed at this mill requires the separation of the sand from the slime so that each of these can be subjected to a different manipulation in treatment.

In order to classify the pulp the vanner tailing, which contain all the battery pulp, except that portion already separated as slime, flows to ten 3½x3½-ft. steel cone classifiers. The sand with some slime settles downward through the upward flowing current and discharges into launders, through which it flows to the sand elevator, while most of the slime is carried in suspension by the upward current and overflows at the top into launders which take it to the slime-settling tanks. This completes the first step in classification, but an auxiliary separation takes place in the sand-collecting tanks, and will be described later.

De-watering and Thickening the Slime

The slime pulp is de-watered and thickened in two parallel rows of masonry tanks, twelve in each row, measuring 9x9 x8 ft. deep, built under the Wilfley and vanner floors and supplemented by three large spitzkastens, each of which is 8x8x30 ft. long and divided into five compartments.

The stream of slime separated from the pulp, as already described, flows through one row of the masonry tanks until that row is filled with partially de-watered slime; then the stream is diverted to the second row, through which it flows and settles as in the other. The slime on the first row, now undisturbed by the flowing current, settles to the bottom of the various compartments; the clarified water remaining at the top is then decanted off and piped to the clear-water sump tanks, from whence it is pumped back to the reservoir tanks for the regular mill service.

In this way these two rows of settling tanks are operated alternately in thickening and de-watering the slime, which when first separated from the sand contains about 12 parts by weight of water to one part of dry pulp, but when de-watered and settled in these tanks the water is reduced to 75 per cent. or three parts of water to one of dry pulp.

Cyanidation of the Slime

The de-watered slime is drawn off from the settling tanks and flows into the charging launders leading to the treatment tanks, of which there are 14, each 30 ft. in diameter and 10 ft. deep; these are equipped in the usual manner with stirring arms and pipe connections for pumping and decanting.

In these tanks the cyanidation proper may be said to begin, although the treatment has been advanced to a considerable extent in the pulping of the ore and the subsequent manipulations to which the pulp has already been subjected, for in these it has been agitated in intimate contact with weak cyanide solution. As classified for treatment, the slime amounts to 53 per cent. of the total dry weight of the mill pulp after concentration, the sand making up the remaining 47 per cent.

In operation, the slime-treatment tanks are filled from the charging launders with the slime, drawn from the de-watering tanks, to the hight of 8 ft., this charge containing 35 tons of slime by dry weight. In filling the tanks the charging launders deliver the slime stream on a "crow's nest," or basket made of latticework, fixed over each tank. In these baskets is placed sufficient dry cyanide to bring up the solution contained in the slime to a strength of 0.1 per cent. KCN. The dry cyanide thus added dissolves slowly but completely in the stream of slime flowing into the tank. The 24 in.

of the tank yet remaining unfilled is filled with working solution carrying 0.1 per cent. KCN drawn from the stock tanks. This addition of solution gives the tank charge a dilution of approximately 85 per cent. of solution, or five parts of water to one of solid. This degree of dilution has been found to be necessary for the satisfactory treatment of the slime and its settlement for decantation.

Agitation begins with the charging of the tank by stirring and pumping, which is continued without intermission for 24 hours. When the tanks have received their charge of pulp, five *botes* of screened commercial burnt lime, weighing 40 lb. each, equivalent to 125 lb. of CaO, to

tate is dissolved in the solution, it is chemically decomposed in the presence of the alkaline or soluble sulphides, with the result that the lead unites with the sulphur and precipitates in the pulp as lead sulphide. Were it not for this reaction, these sulphides would combine with the silver cyanide in solution and precipitate the silver in the pulp as silver sulphides, which would be lost in the tailing.

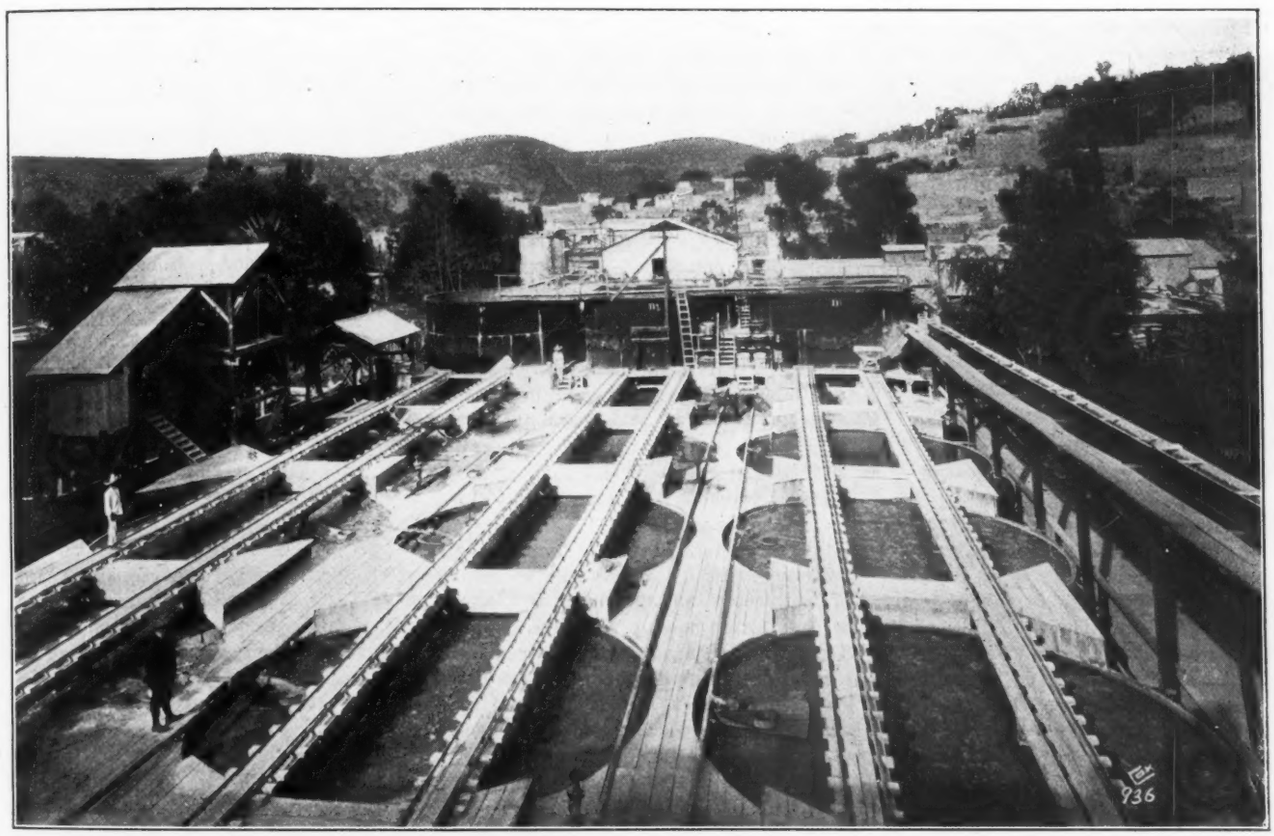
After 24 hours, agitation is stopped and the charge allowed to settle for six hours, during which time the slime settles so as to leave about 36 in. of clear solution on the top, which is decanted off and sent to the clarifying tanks.

Then agitation of the charge is again

cantations are the same in each case. These eight washes are followed by two water washes, after each of which the charge is allowed to settle and the clear supernatant liquor is decanted off and sent to the clarifying tanks.

The charge is now pumped to one of the two high settlement tanks, where it mixes with about 6 ft. of weak solution previously pumped into the tank. The charge is allowed to remain in the tank as long a time as can be spared for settlement; then the clear solution is decanted off and sent to the clarifying tanks. The remaining pulp, containing about 70 per cent. moisture, is then discharged.

The treatment cycle, as described, is



SECOND-TREATMENT TANKS IN FOREGROUND; STOCK-SOLUTION TANKS IN THE DISTANCE. GUANAJUATO CONSOLIDATED MINING AND MILLING COMPANY

gether with 8 kg. of lead acetate, are added.

This addition of lime serves chemical and mechanical purposes essential for the treatment; the former by furnishing the alkali for neutralizing the sulphuric acid in the pulp and by providing the necessary margin of protective alkalinity for the cyanide solutions; and the latter by effecting the coagulation of the slime, which causes the slime to settle in the tank, leaving the clear, silver-bearing solution on the top, whence it is decanted and sent to the clarifying tanks.

The action of the lead acetate is purely a chemical one. Its beneficial effect is due to the fact that, when the lead ace-

commenced, and the 3 ft. of tank space, from which the clear solution had been decanted, is again filled with solution from the same stock tanks as before, and the same amounts of lime and lead acetate are added. The agitation is continued as before until the charge is thoroughly mixed with the newly added solution, which usually requires about half an hour. The pulp is then allowed to settle for half an hour, when decantation of the clear solution at the top, amounting to about 18 in. of tank depth, is commenced and carried on as before.

Six other washes similar to the one just described are given and the quantities of lime and solution added and the de-

given to all the slime tanks, except that slight variations in the length of treatment and the chemicals may be found necessary or advantageous from time to time.

Clarifying the Solution

All the solutions decanted from the slime tanks are clarified before precipitation. The decanted solutions going to the clarifying tanks are first received in an intermediate sump tank, from which they are pumped into the first of the two clarifying tanks, each of which is 26 ft. in diameter and 12 ft. high. The solution flows from the first into the second tank, passing through two or three curtain screens of burlap and cocoa matting on

the way. From the second tank the solutions, which have thus been settled, strained and clarified, flow to the zinc boxes for precipitation.

Assaying the Pulp and Solutions

The pulp and solutions are assayed and tested at the various stages throughout the slime treatment, in order to determine the amount of gold and silver remaining in the slime and the extraction obtained at the various stages of the treatment.

The weight of the dry slime and its value as charged into the tanks are determined from samples taken at frequent intervals of time, across the stream of pulp as it discharges from the delivery launder into the tank. This total sample amounts to 1 cu.ft. From this amount an average sample is taken and from this the percentage of moisture in each cubic foot of the tank charge and the value of the dry slime are determined. The assay results of these samples form the basis for the commercial calculations of the treatment. The strength of the solutions in KCN is determined at each stage of the treatment.

As the pulp is discharged from the high settlement tanks it is sampled in a similar manner, and from the assay results of this sample the value of the slime tailing and the amount of cyanide lost in the discharged tailing is determined. The amount of extraction is calculated by difference.

Sand Treatment

Returning to the classification of the mill pulp we find that, as discharged in the underflow from the cone classifiers, the sand carries with it a considerable amount of slime. This underflow of the classifiers flows to the boot of a duplicate set of bucket elevators, one of which is continually in operation. Consequently in case of accident, or repairs, to either, the other is ready to carry on the work, and no shutdown is necessary. These elevators are 65 ft. between centers and in operation lift the sand to the charging launder. Through this launder the pulp flows to the collecting tanks, where the slime still remaining with the sand is washed out and flows back to the slime de-watering tanks.

This separation of the slime is effected by passing the pulp, before it goes to the collecting tanks, through cone classifiers, 18x18 in., one of which is set over each collecting tank. When the sand is passing through these cones, most of the slime associated with it is carried upward in suspension, and overflows at the top of the cone into a launder, which carries it to the slime-settling tanks.

The sand discharged as underflow from the cone is delivered at the side of the collecting tank, where it piles up, sloping away gradually to the opposite side of the tank, where a slot door, closed with perforated wooden slats covered by a canvas roll curtain, allows the water and slime to pass through and join the slime overflow of the cone and flow with it to the settling tanks. If the sand should still contain a quantity of slime too large for good leaching, as is usually the case, a boy with a hose directs a small stream of water over the surface of the sand, as it collects in the tank; this washes out practically all the slime and leaves the sand quite clean of any slime; hence in the best possible condition for leaching. There are seven of these tanks, each 26 ft. in diameter and 5 ft. deep, and fitted with filter bottoms, drainage pipes and bottom doors for discharging.

Preliminary Treatment

The sand thus collected receives the first stage of treatment in the same tank in which it is collected, and so the collecting tanks become preliminary-treatment tanks, where the cycle of treatment is as follows: Collecting the charge, 15 hours; draining the charge, 15 hours; first saturation, 20 tons 0.3 per cent. KCN solution, 12 hours; percolation and drainage, 6 hours; second saturation, same tonnage and strength, 12 hours; percolation and drainage, 12 hours; transferring charge, 6 hours; total time, 78 hours.

After the charge has been collected the drainage period of 15 hours reduces the moisture in it to 18 per cent. The charge is then core-sampled, and the value of the sand is obtained by assaying this sample. Then, as just stated, the first saturation with 20 tons of 0.3 per cent. cyanide solution is given, together with 20 grams of lead acetate, and the charge is allowed to soak for 12 hours. When the solution for the first saturation is being run into the tank a basket containing about 25 kg. of dry sodium cyanide is placed under the stream, which dissolves it slowly and carries it down through the charge. This addition of cyanide is calculated to be sufficient to bring the solution in the charge up to the regular working strength of solution, 0.3 to 0.32 per cent. cyanide. After the first saturation has lasted 12 hours, the solution valves underneath the filter bottoms in the tanks are opened and percolation commences. This is usually finished in three hours, after which the charge is allowed three hours to drain and become aërated.

The second saturation is identical in all respects to the first and is given the same time for contact, but the period allowed for drainage and aëration is 12 hours, which results in the reduction of moisture to 14 per cent.

The solution, drained from these saturations, flows direct to the zinc room and passes through the "strong" zinc boxes where the gold and silver in the solution are precipitated. The solutions are sampled on issuing from the tanks at the end of the various treatment periods, the drainage pipes being tapped for this purpose, and the sample is assayed in order to ascertain the percentage of cyanide and lime contained, and the amount of gold and silver dissolved during the saturation periods, so as to judge of the progress of the treatment. This constitutes the preliminary treatment, during which from 35 to 40 per cent. of the original gold and silver content is usually extracted.

There are seven of these collecting, preliminary, or first-treatment tanks, as they are variously called, each of which holds 90 tons (dry weight) of classified sand. The cycle of treatment in each tank is identical.

Transferring the Charge

When the first treatment is complete the four discharge doors in the bottom of the tank are opened, and the discharge of sand into tram cars commences. The cars receiving the discharged sands are double side-dumping cars, and run on a double row of tracks laid under the first-treatment and over the second-treatment tanks. As the sand is being transferred, it is sampled by taking a handful from each car and throwing it in the sample box, which is made of wood with an interior measurement of 2 cu.ft. The size of the handfuls taken are so gaged that the sample box is just filled by the time that all the charge has been transferred. When the tank is empty, the discharge doors are closed and it is then ready to receive another charge. The sample box as filled constitutes the sample unit, from which the following determinations are made: (a) The specific gravity of a cubic foot of sand received in the second-treatment tanks, from which the tonnage is calculated; (b) the contained moisture, which ranges from 12 to 14 per cent.; and (c) the silver and gold content which, when compared with the assay-value of the solution sample already taken, shows the extraction effected at the termination of the first treatment.

Second Treatment

The sands are given a second treatment in 15 tanks set in three rows of five each, the tanks being 26 ft. in diameter and 6 ft. deep, fitted with filter bottoms, drainage pipes and two discharge doors, placed in the bottom. In the second-treatment tanks the cycle of treatment averages about 11 days.

While the tanks are being charged, which takes six hours, a quantity of commercial lime equal to 450 kg. of pure lime is added and distributed uniformly throughout the charge. Then the sand is saturated with 30 tons of strong (0.3 per cent.) solution, to which is added 25 kg. of dry cyanide, and allowed to remain in the tanks for a day. Solution is then allowed to percolate through the charge

for six hours, the solution going direct to the zinc boxes. The sands are then saturated a second time with the same strength and tonnage of the regular working solution, and percolation and addition of the regular strong working solution is continued simultaneously for six and one-half days. The effluent solution goes to the zinc boxes. The sand is then washed with weak solution containing 0.15 cyanide for two days and then with water for 18 hours. The tank is then sampled and sluiced out. This requires six hours longer.

The total treatment cycle, including the preliminary treatment, occupies 14 days. During this time an average of 4 kg. of lead acetate, or 45 grams per ton is added.

A daily ledger account is kept of each tank treated, in which the time, method and results of each stage of the treatment are entered, and the extraction percentage is plotted on a blank extraction chart, which shows the rate of extraction by days as the treatment advances.

Zinc-room Practice

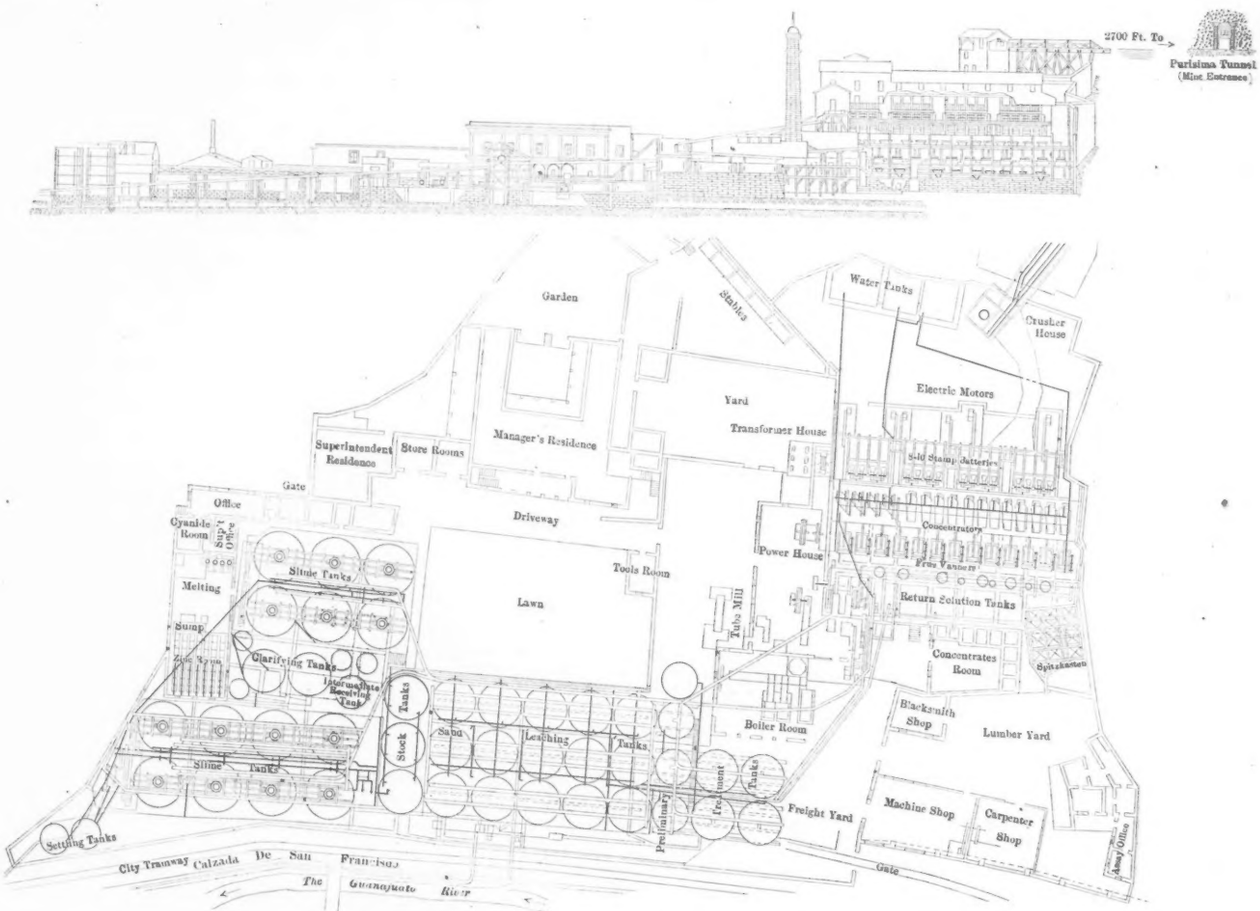
The precipitation of the gold and silver dissolved from the pulp by the cyanide solutions is effected in zinc boxes. Two classes of solution, one weak, the other strong, enter the zinc room through their respective pipe lines and flow through the zinc boxes, where the gold and the silver are precipitated on zinc shavings.

The tonnage of solution used is determined from stock-tank measurement and the gold and silver in the solutions on entering and leaving the zinc room are determined by assay of the samples which are obtained from pet-cocks placed on the under side of the strong- and weak-solution pipes carrying the solutions into the zinc room. A ¼-in. nipple and pet-cock is inserted in a hole drilled into the pipe. The pet-cocks are slightly opened so as to allow a continuous drip of solution, which is caught in sample bottles large enough to hold the drip from the strong- and weak-solution pipes for 24 hours. These samples are assayed and the result, multiplied by the tonnage of solution used, indicates the total value of the solution entering the boxes. The percentage of lime carried in solution is determined from the same sample. In the same way the precipitated solutions flowing away from the zinc boxes are sampled and assayed and the amount of gold and silver precipitated is approximately determined by difference.

There are seven rows of zinc boxes having eight compartments (a double series) in each row, each compartment being 2 ft. deep, 3 ft. wide and 4 ft. long. From the length of each compartment 4 in. are cut off by the baffle partition; so the zinc-holding capacity of each compartment when filled within 3 in. of the top is 3 ft. x 3 ft. 8 in. or about 20 cu.ft. As there are 56 of these box compartments, the aggregate zinc-holding capacity is 1120 cu.ft. When the zinc shavings are laid snugly in these boxes each cu.ft. contains 8 lb. of shavings; the total weight, therefore, of zinc shavings, which are cut 1/300 in. wide, is 8960 lb., or about 4 metric tons.

By the well known chemical reaction the cyanide solutions, flowing through these boxes, deposit the silver and gold which they contain on the zinc shavings, this reaction causing a consumption of the zinc, which amounts to 1.3 lb. per ton of pulp treated, or 0.08 lb. per ton of solution in circulation. The solutions, after passing through the zinc boxes, are received in sump tanks, from which they are pumped to the stock-solution tanks, where, by the addition of dry cyanide, they are again brought up to working strength, when they are ready for use as before. A portion of the precipitated solution is pumped to the reservoir storage tanks for mill service.

The weight of solution precipitated per ton of pulp treated and the strength of



HACIENDA DE SAN FRANCISCO, THE MILL BELONGING TO THE GUANAJUATO CONSOLIDATED MINING AND MILLING COMPANY

the solutions used, are as follows: In sand treatment, 7 tons, containing 0.35 per cent. cyanide; 1.4 tons, containing 0.10 per cent. cyanide; 0.7 tons of wash water; in slime treatment, 6.4 tons, containing 0.10 per cent. KCN.

The total solution used weighs 15.5 tons and contains a total of 58.26 lb. of cyanide worth $23.30. Therefore, for the daily tonnage treated, 260 tons, 4030 tons of solution pass through the zinc boxes, which provide 2.2 lb. of zinc shaving for the precipitation of the gold and silver in each ton of solution.

Clean-Up

The zinc boxes are cleaned up three times a month. During the clean-up the gold and silver precipitate deposited on the zinc shavings is washed off and passes through the drain pipe, in the bottom of each compartment, into a launder, in which it is carried to the clean-up sump tank. The contents of this sump tank is pumped through a Johnston filter, from which the cakes of pressed precipitate are removed to a large tray and mixed with the fluxes required for melting, the proportion of these being: 100 parts precipitate, 30 parts borax and 18 parts sodium bicarbonate.

The cakes of precipitate from the press contain about 30 per cent. moisture, 52 per cent. pure silver and 3 per cent. gold, with varying percentages of zinc, lead, copper, sulphur and silica. The precipitate, when mixed with the fluxes, is filled into shallow sheet-iron trays and placed in a steam-drying cabinet to remove the moisture.

When dried the precipitate is filled into Dixon No. 300 graphite crucibles, melted and cast into bars weighing about 32 kg. each. The bars contain 860 parts by weight of silver, 5 parts of gold, the remaining 335 parts being made up of zinc and lead. The bars are sampled by a boring on the top and on the bottom to the depth of ¾ in.; this sample is assayed and the exact fineness of the silver and gold ascertained, when the bars are sold to the *Sociedad Afinadora de Metales*, the refining company in Mexico City.

The average consumption and value of the chemicals and supplies used in the zinc room per kilogram of fine silver and gold, during a period of six months, are:

Zinc, 4.830 kg	$1.680
Cutting zinc	0.096
Borax, 370 kg	0.222
Bicarbonate of soda, 224 kg	0.049
Crucibles	0.223
Total per kg. of fine silver and gold	$2.660

Recovery

In the operations described, concentration and cyanidation, about 87 per cent. of the total gold and silver in the crude ore is recovered, but this percentage will be considerably increased when a suitable filter press is added. It is estimated that 2 oz. of silver and 4 lb. of cyanide now dissolved in solution and lost with each ton of slime tailing will be recovered, which is equal in value to 3 *pesos*, which on 4000 tons of slime treated last month would equal 12,000 *pesos*.

It has been observed in the operation of this plant that the assay-value of the tailing remains almost uniform whether the pulp treated contains higher or lower value, proving to a certain extent that in cyanidation, as in other metallurgical processes, there is an "irreducible minimum" of tailing loss under average working conditions; this it is not profitable to reduce as the cost would exceed the gain.

This also is a fundamental condition in the patio process and accounts for the high percentage of saving effected by that process, because the general average of the ore treated by it carried about a kilo of silver per ton of ore.

The following table illustrates how this principle affects the percentage of recovery on various grades of pulp, assuming 60 grams of silver per ton to be the economic "irreducible minimum."

	Loss in Treatment		
Grade of Pulp. Grams Silver per Ton.	Tailings Loss. Grams Silver per Ton.	Loss in Per Cent.	Recovery in Per Cent.
200	60	30	70
400	60	15	85
600	60	10	90
800	60	7.5	92.5
1000	60	6	94

I found this ratio to be remarkably well sustained in numerous tests made on all grades of ore and the concentrate produced in this plant, and I have information from a reliable source, where the actual recovery by cyanidation of concentrate in a two months' trial run, made with a grinding pan, has equalled 98 per cent. of the original ore content.

In another respect cyanidation resembles the patio process, for in the patio process, for every ounce of silver recovered there was a fixed loss of quicksilver, and in the cyanidation of silver ores there is a fixed loss of cyanide for each ounce of silver dissolved from the pulp. In both processes the loss would be greatly increased by an association of certain base metals in the pulp and to a certain degree this fact is observed in all the metallurgical processes.

As a general rule it may be stated that an ore assaying 12.5 oz. or 400 grams per ton, if suitable and occurring in fair-size deposits, under usual conditions for mining and milling, can be operated with satisfactory profit by using cyanidation, as is shown by the following calculation:

400-gram ore, at 3.7c. per gram, $14.80 gross value—		
Cost of mining	$5.00	
Cost of milling and cyanidation	3.25	
Loss in treatment, 15 per cent.	2.22	
Taxes and marketing, 7 per cent.	1.03	
Total costs		$11.50
Profit		3.30
Balancing		$14.80

If the patio process were used and the same recovery effected, the cost of treatment and the government taxes and marketing costs on the recovered bullion would amount to $14.48, which would leave 32c. to pay the other costs of realization on the ore. In table form the cost of treating the same grade of ore by the patio process would be approximately:

Mining	$5.00		
Patio treatment	13.45		
Loss in treatment, 15 per cent	2.22		
Taxes and marketing, 7 per cent	1.03		
Total costs		$21.70	
Value in the ore		14.80	
Loss		6.90	per ton.
Contrasted with the profit of		3.30	per ton.
In favor of cyanidation		$10.20	per ton.

This illustrates the principal reason why the time-honored patio process is abandoned in this country and its modification, the pan-amalgamation process, in the United States. These processes cannot compete in economy with cyanidation in the treatment of low-grade ores. At the present price of silver, all silver ores may truthfully be said to be low-grade.

Costs

The low cost of cyanidation is its most attractive feature, for what does it matter if a high percentage of the precious metal in an ore can be recovered at a cost greater than the value of the increased percentage recovered? The costs apportioned to and those pertaining exclusively to cyanidation in this plant are shown in the following table:

	Cost, per Ton.
Labor	$0.41
Supplies, including cyanide, etc.	2.06
Electric power	0.26
Assays	0.12
General office expense	0.14
Hacienda expense, management, etc.	0.24
Total	$3.2300
Add, cost of crushing and sorting ore	0.1648
Milling costs	1.1000
Total cost	$4.4948

Plant Design

That portion of the plant exclusively used for cyanidation is built on a flat site and consists of steel tanks as described, except a few sump tanks, referred to later, and the slime-settling or de-watering tanks, which are of masonry and for convenience built immediately under the concentrator floor. To overcome as far as possible the inconvenience of the flat site, the masonry wall upon which the steel tanks stand are built to a sufficient hight above the ground level to leave convenient space underneath for launders, pipe connections and attendance, while the slime tanks are arranged, as to hight, so they are charged by launders from the de-watering tanks. The preliminary-treatment sand tanks are placed on wall foun-

dations built to a hight of 14 ft.; this hight, which is 7 ft. above the level of the top of the second-treatment tanks, allows the sand discharged from the first-treatment tanks to be received in cars and trammed over the top and dumped into the second-treatment tanks. The different stock-solution tanks sit on high masonry foundations between the sand and slime tanks, so that the weak or strong solutions flow from them by gravity into any treatment tank desired, except that the solution has to be pumped into the first-treatment sand tanks, as required. The intermediary, or sump, tanks, which receive the solutions from all the slime tanks, are set in a pit, so as to give flow grade for the decanted solutions from the slime tanks. From these tanks the solution is pumped into the clarifying tanks, from which it flows to the zinc boxes.

The precipitated solutions flowing from the zinc boxes are caught in sump tanks, built of masonry lined with cement, from whence the solutions are pumped to the stock tanks referred to, and again brought to the regular working strengths by the addition of the required amount of cyanide.

Considerable care was taken in the design, although it necessitated extra expense in construction, to minimize in this way the disadvantages of the level site where the plant stands. An illustration accompanying this article shows the plant in plan and longitudinal section as drawn to scale; a study of this will make this description more easily understood.

The design of this plant follows the general lines of the El Oro plants for cyaniding gold ores, except as to tankage capacity, which is greater, so as to meet the requirements of silver cyanidation. All the plants in Guanajuato are of the same general type of construction, modified somewhat to meet local conditions of site and the mechanical means of handling the pulp.

Most of the Guanajuato companies have added presses to their cyanide plants for filtering the slime tailing. This has diminished the cyanide solution which would otherwise run to waste and be lost; besides, the recovery of dissolved gold and silver that was lost in the tailing previous to their installation increases the percentage of extraction. Experiments have been made to obtain a suitable filter press to add to this plant, and a type has been determined upon, which will, it is thought, give satisfactory results.

The plant, described in this paper, although carefully designed for economic operations and well abreast of the best practice in construction even at this time, is not what I would recommend now for a new installation.

The change in design that I would now advise has matured under a careful study of the operations of this plant and is suggested by the gradual change in the type of cyanide plants recently installed elsewhere, which show a decided tendency toward finer grinding and more efficient mechanical facilities for handling the pulp.

Sand leaching, as now practiced in the majority of plants, should no longer be made a prominent feature in a cyanide plant, for the solutions cannot dissolve the fine metallic grains that may be enveloped, in whole or in part, in the larger grains of quartz during the economic cycle of treatment possible to give in ordinary sand leaching. This, of course, is not a hard and fast rule in all cases, for in some instances the cost of fine grinding may equal or exceed the additional extraction obtained by finer grinding of the pulp. But in most ores a considerable part of the silver sulphides are so finely disseminated in the gangue that it becomes necessary to grind to a pulp fine enough to pass a 150-mesh screen, before the metallic grains are sufficiently liberated from the inclosing quartz, to permit a satisfactory extraction of the silver by cyanidation.

In the cyanidation of finely ground or slimed pulp, agitation by stirring arms is now the practice in nearly all cyanide plants. This mechanical agitation can be effected more economically and efficiently by air lifts in tall narrow tanks, say 20 ft. in diameter, 35 or 40 ft. high. By this method a much greater percentage of fine sands in the slime can be advantageously treated than would be possible by the stirring and pumping method of agitation; and with the addition of a good filter press, with ample margin of capacity, I think 96 hours would be sufficient for a complete cycle of treatment, in which a higher percentage of extraction would be obtained than by the 14-day cycle of treatment necessary for sand in the usual type of plant operating here in Guanajuato.

No new cyanide plant should be designed without first carefully considering the advantages to be derived from fine grinding, not necessarily sliming; 50 per cent. of the pulp of quartzoze ores ground fine enough to pass a 150-mesh screen will be leachable sand if slime is carefully washed out, but at the same time all pulp that will pass a 150-mesh screen may be treated more economically as a slime.

The improvement suggested would result in greater economy in plant construction and operation and in a higher extraction than is possible in the usual type of plant of which the one described in this paper is characteristic.

Sands as coarse as 40-mesh can be agitated in a Brown vat by means of air. Owing to the fact that in Mexico this vat was first used at Pachuca, the Brown vat is frequently called the Pachuca vat in that country.

The Patio Process

The patio process was invented by Bartolomé de Medina at Pachuca, Mexico in 1557. At first the ore was shoveled and mixed by men and it was not until 1793 that mules and horses were used to mix the *torta*, or bed of pulp. This reduced the cost of the mixing about 75 per cent. It was only a few years ago that the chemistry of the process was closely studied and that an approximate understanding of the reactions was obtained. A satisfactory mechanical mixer for use in the patio process was not invented until a few years age. This works on the principle of a gang plow.

The patio process is limited in its use not only by its high cost but also by the fact that a poor extraction is obtained when treating ores carrying much gold or when much sulphur is present in the ore. Formerly the use of the cyanide process was limited in Mexico not by its cost but by the fact that a poor extraction was obtained from silver ores; the work of the last four years at Guanajuato and in other silver districts of Mexico has removed this limitation, for now a high extraction is obtained on silver ores by using fine grinding and a long treatment.

Conveying at El Oro Mill, El Oro, Mexico

The coarser sand at El Oro mill, El Oro, Mexico, from the stamp-battery pulp and from the tube mills is passed through a blanket sluice, 20 ft. long, so as to remove the iron from the sands before it is treated in the leaching tanks with cyanide. Some sulphide is also concentrated from the ore in this sluice.

The pulp is conveyed from the stamp mill to the cyanide mill in a launder set at a grade of 2.1 per cent. This launder is 8 in. wide, and has wooden sides to which a V-shaped sheet-iron bottom is nailed. The pulp from the battery contains about one part of solution to one part of ore. A 35-mesh pulp flows through this launder nicely; with a 30-mesh pulp a little more water has to be added to avoid choking; but when a 25-mesh screen is used, the coarse sand chokes the sluice frequently.

The shapes of Indian implements at the rooms of the Chamber of Commerce of Grants Pass, Oregon, which were discovered in a creek bed under several feet of auriferous gravel and in the central depression of which were found grains of gold hammered into the pores of the lava, indicate that these implements were used for pulverizing auriferous quartz obtained either from the creek bed or from the small pockets of rich gold-quartz ore characteristic of southern Oregon and northern California.

Diamond Drilling at Mapimi *

By J. F. Bennett†

Mapimí is in Durango, about 24 kilometers southwest of Bermejillo, with which it is connected by a 30-in. gage road, owned and operated by the Compania Minera de Peñoles. It is at the northwestern extremity of the Sierra de la Bufa de Mapimí. The company's general offices, power plant, and reduction works are at Mapimí, but its mines are at Ojuela, 10 kilometers away in the hills. The formation encountered is one which makes diamond drilling an economic necessity. The ore, a silver-lead, occurring as sulphide, oxide and carbonate, is deposited irregularly in pockets of varying dimensions, usually connected by pipes or stringers through the country rock of limestone. The mine is opened by levels from the shaft, and on each level drifts are run at right angles, about 120 meters apart. The territory covered by the mine is thus divided by the levels and drifts into cubes. These cubes are carefully probed by diamond-drill holes, run from the drifts, in all directions, to determine the location of the pockets, their size and frequency, and the best points from which to reach them. By this method it is impossible to miss any body of ore of appreciable extent, and at the same time, if ore is not discovered, the expense of drifting is avoided.

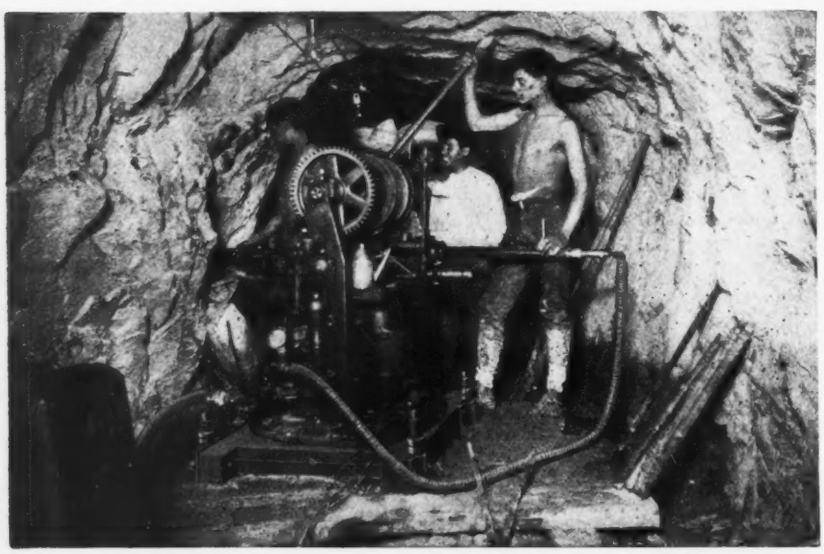
The company at present employs 17 diamond drills, and performs about 12,000 ft. of core drilling per month. The drill holes are run at right angles to the drifts, about five meters apart, to an average depth of about 60 meters. Horizontal holes predominate, but there is also considerable angle work.

Four of the machines are of the Sullivan "R" type, which have a capacity of 300 ft. in depth and remove a 15/16-in. core. These drills are fitted with improved screw feed with friction escapement, and are operated by electric motors on a 250-volt direct current, which is stepped down from the 6600-volt alternating current transmitted from the power plant at Mapimí. The remaining drills are of an early Swedish type. They are run by small electric motors, but the diamond bit is advanced by hand.

The average cost of drilling for the year 1906 for all the drills was about 2.10 *pesos* per meter. Two Mexicans are employed on each drill, a runner at 2.00 *pesos* and a helper at 1.25 *pesos*. They average about five meters per 10-hour shift with the Swedish drills and seven meters with the Sullivan "R" machines.

Owing to the soft, even character of the rock, it is possible to use small carbons, weighing about one karat, of a grade costing $40 per karat. The accompanying table shows the average cost of the company's drilling work for the first five months of 1907. All values are figured in Mexican currency.

OJUELA FROM ONE OF THE SEVERAL SHAFTS. THE ORE IS CARRIED TO THE COG-ROAD ACROSS THE SUSPENSION BRIDGE



A SULLIVAN ELECTRIC DIAMOND DRILL IN THE MINES OF THE COMPANIA MINERA DE PENOLES, OJUELA, DURANGO, MEXICO

Electric power, generated at Mapimí, is employed to operate air compressors, hoists, pumps and to light the mines. Air drills, size 2¼-in. including about a dozen Sullivan "US" machines, are employed for development work. A suspension bridge connects one of the principal shafts with the ore bins at the terminus of the railroad which connects Ojuela with Mapimi. This line includes a rack road three kilometers long, with a grade of from 10 to 14 per cent., running from Ojuela to the foot of the mountain.

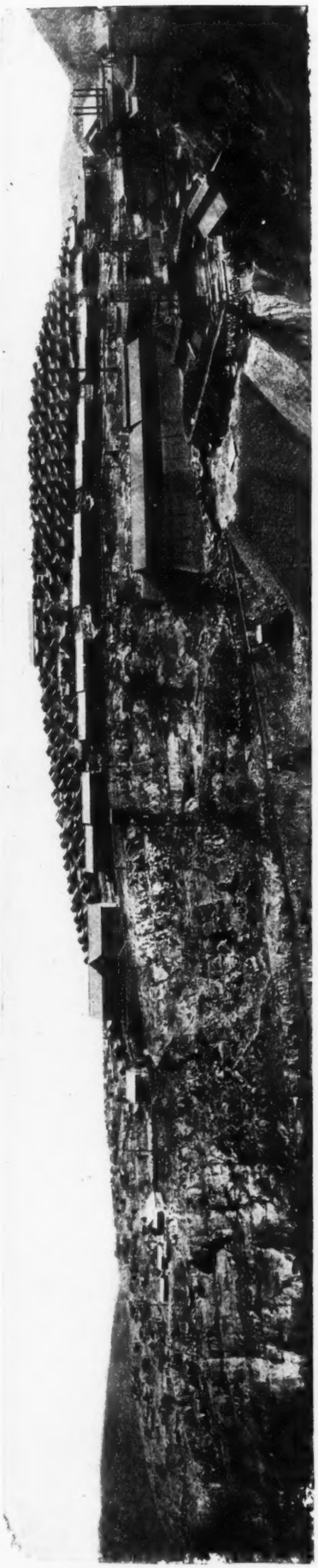
The reduction plant includes five 46x162-in. lead stacks; roasters and Huntington converters, and a 200-ton concentrating plant. It is capable of treating about 1000 tons of ore per day.

COST OF DIAMOND DRILLING AT MAPIMI (1907).

Month.	Labor, Including Salaries of Foreman, Setter, etc. per Meter.	Diamonds, per Meter at $40 per Karat.	Total Cost, Including Power, etc. per Meter.	Average Drilled per Month, per Machine, Meters.
January	1.01	.09	1.74	290
February	0.91	.24	1.76	266
March	1.00	.08	1.71	250
April	0.93	.22	1.66	286
May	1.19	.15	1.93	270
Average for 5 Mos.	1.01	.156	1.76	272.4

*Abstract of an article in *Mine and Quarry*.

†El Paso, Texas.



PANORAMA OF OJUELA, SHOWING MINERS' HOUSES, ONE OF THE SHAFTS, AND RACK ROAD. THE SMELTER, AT MAPIMI, IS FAR TO THE LEFT IN THE VALLEY

Artificial Vein Formation

By R. C. Canby*

The present interest in economic geology, as evinced by the wide-spread discussion of mineral formations in the mining and technical journals, would make it appear an opportune time to describe in a general way, the occurrence of artificial vein formations in heap-roasted matte.

Some years ago, when I took charge of the San Luis Potosi smelter, I found that, owing to an inadequate roaster capacity, there had accumulated a very large quantity of first matte. In addition to this, we were about to increase the amount of production considerably, not only by doubling the number of furnaces in operation, but also by the use of augmented blast to increase their capacity greatly. Although the erection of additional roasting furnaces was commenced, it was apparent that several months would be required before we could have the additional roasting plant in operation. I decided therefore, upon heap-roasting the accumulated matte.

I figured that by making the heaps of larger size, the proportion of strippings would be greatly reduced, or entirely eliminated. I therefore decided upon 1800 to 2000 tons as the size of each heap. The usual bedding of cordwood, with suitable air passages, vents, etc., was prepared. The greatest possible care was observed during the burning, especially in the earlier stages, to regulate the draft properly, so as to cause uniform burning and prevent any local fusing of the matte. The settling of the heap, due to the consumption of the under layers of cordwood, caused the formation of a number of cracks, some longitudinal and others radiating from the chimney vents.

These 1800-ton heaps required about three months to burn. Around the chimney vents there were accumulations of brilliant arsenic and antimony crystals. Dense fumes were emitted from the chimney vents during the burning, at times showing strongly the yellow color of sublimed sulphur. When the heap was burned, the roast was sufficiently complete to permit the smelting of the entire pile, disregarding the stripping, so that it was attacked from one end, working clear across and keeping a uniform face, in which were shown several well formed mineralized veins, containing sulphides and some sublimed sulphur. From their appearance, one could not distinguish whether pyrite, chalcopyrite or pyrrhotite predominated; while in places there were small quantities of well crystallized galena. The pyrites minerals were not crystallized, appearing for the most part, as a coating on the matte surfaces, with occasional pockets of quite massive pyrite.

The crude matte, before roasting, ranged from 5 to 7 per cent. copper, and about 12 per cent. lead. There was relatively but a small quantity of galena in the veins, but in a few places, it appeared to form actually banded deposits, and in every case, there seemed to be no doubt that the galena had been formed from the matte.

It was a coincidence that the burning of these large matte heaps was completed just at the time (1899) when copper prices took a sudden jump about 12 up to 17c., so that every effort was made to convert them as rapidly as possible into shipping product. The use of the extra furnaces, with accompanying additional ore and matte analyses, together with the already somewhat crowded work, seemed to preclude at the time such extra analyses as an investigation into the composition of these artificial vein minerals required, though they were undoubtedly warranted.

The samples which I had set aside were unfortunately crushed down without having made a sufficiently careful separation of the gangue, which, in this case was, of course, roasted matte, nor of the sublimed sulphur; so we did not obtain the actual composition of the pyrite, chalcopyrite and pyrrhotite, and the heaps having been smelted, new samples were not obtainable.

Undoubtedly the sulphides were formed from the iron, copper and lead in the matte, under the action of the volumes of highly heated sulphurous-acid fumes in a reducing atmosphere, assured by the sublimed sulphur. The pyrites minerals did not appear to be crystalline, and were probably at no time in an actually fused state, though in places they may have been pasty. As stated above, there was very little galena found, but this did seem to be crystallized in places.

In smaller matte heaps, these veins could not have been formed so perfectly. As the heaps only occupied about three months in burning, these minerals in the veins must have formed in somewhat less time than that.

The observation of such a phenomenon would seem to suggest that possibly many of the constructive and destructive geological operations have required relatively less time than we are apt to ascribe to them; certainly so far as plutonic depositions of ores are concerned. The rapid oxidation of middlings containing arsenopyrite, is noticeable. In one case which came under my observation, an old middlings pile which was being excavated and wheeled to the mill for re-concentration, became so heated that the peons were obliged to stand on planks, the heat being greater than their feet could endure, with only their *huaraches* to protect them. The quick change of chalcopyrite in ore piles to carbonates is observable at times, but it is certainly remarkable how rapid was the plutonic formation of such sulphide-mineral veins.

*Mining engineer, El Paso, Texas.

The Recovery of Anthracite from Culm Banks

A Plant Costing $25,000 to Complete, May Net a Yearly Profit of $41,950, or 168 Per Cent. on the Investment

BY RICHARD LEE

It has been estimated by geologists that the area underlaid with anthracite coal in Pennsylvania amounts to less than 1 per cent. of the original coal area; more than 99 per cent. having been wasted by natural erosion. When the early operators mined the coal, they marketed less than 30 per cent. of the contents of the seam, this inefficiency being due to the crude methods used in mining and preparing the commodity. Such carelessness resulted from the erroneous idea that whole mountains were practically a solid mass of coal. The huge culm piles, which, throughout the anthracite field, are a constant eyesore and disfigurement to the landscape, are the direct result of early wasteful methods.

Prior to 1866, the smallest size of coal marketed was nut coal, which was passed through a 1⅜-in. mesh and over a screen with meshes 1 in. square. In 1867, pea coal was first prepared and marketed; this meant a saving of 15 per cent. of the total amount of coal mined. In 1877, the size now known as buckwheat was first introduced as steam coal, and rice, barley, and culm were first shipped to market.

FIG. 3. CONVEYER LINE LEADING FROM CULM BANK TO BREAKER

Cost of Construction

In 1891, washeries were first erected in the anthracite field at Dodson, and the Black Diamond collieries in the Wyoming valley. They were of portable construction and looked upon as somewhat of an experiment, but proved successful. Since then the idea has been adopted at many collieries where structures of more substantial design have been erected. The capital involved in building such a plant depends directly upon the amount of material treated per day. A washery capable of treating from 500 to 1000 tons per day, will cost from $25,000 to $35,000; much, however, depends on the kind of machinery installed. At some collieries old breakers have been transformed into washeries, in which case the cost of transformation often did not exceed $5000.

The usual size of a modern washery is 50 ft. by 70 ft. on the ground, but the question of size depends largely on the design and on local conditions. At some of the more recent collieries where machinery for treating small sizes has been installed, the bank coal is brought directly to the breaker in cars and the material is there treated as if it were fresh-mined coal, thus obviating the erection of a special plant.

In constructing a modern washery, the materials required are similar to those needed for building a breaker. The design calls for approximately 300,000 ft. of board, while the main timber supports are usually 12x12 in. in section; short

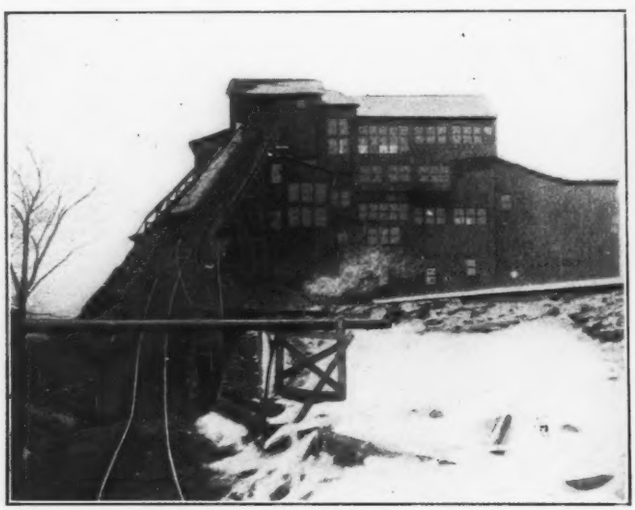


FIG. 1. AN ABANDONED BREAKER NOW USED AS A WASHERY

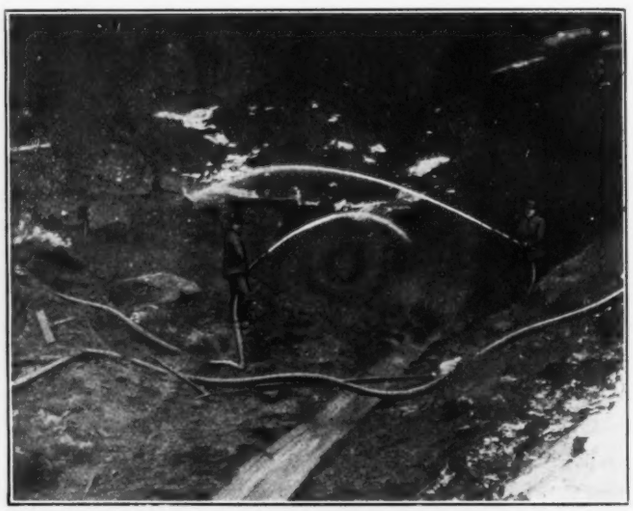


FIG. 2. FLUSHING CULM FROM A BANK INTO A STEEL CHUTE

Estimates Show 316,000,000 Tons in Culm Piles

The small sizes of coal formerly sent to the dirt banks are now sent to market. The total amount of marketable coal originally in these culm banks has been estimated at 316,000,000 tons, composed of the following sizes in percentage: Chestnut, 10 per cent.; pea, 20 per cent.; buckwheat, 30 per cent.; rice, 25 per cent.; barley, 15 per cent. Of 316 million tons of marketable coal in the culm piles, nearly 26 million tons have been sent to the markets during the years from 1890 to January, 1907, besides the coal gained from this source and used in the fire rooms at the collieries. It is estimated that the culm piles have, during the last 18 years, supplied four million tons of coal for use under mine boilers, and that there still remains in the piles of the anthracite field 286,000,000 tons of small-sized coal.

braces are generally 8x8 in., while 12x14-in. or 14x14-in. oak timbers are used for supporting the machinery. The coal is usually elevated to the highest part of the building by a bucket elevator and there discharged into a hopper placed on top of two screens, where the material is separated into various sizes. The top screen generally has 1½-in. openings for a part of its length, and then diverges to a wider space, while the lower screen is perforated with ⅞-in. holes.

The material passed over the first screen in a large washery is brought into a chute where the usual method of hand picking by boys is used. The egg, stove and nut sizes are separated by means of screens; but at some of the washeries where the culm piles are of recent origin, the small amount of large sizes of coal in the culm does not warrant such careful preparation. The chief machinery used in treating culm is the screen, the emery picker, the roll, the crusher and the jig.

Water is an important item in the proper treatment of culm. It has been estimated that approximately 500 gal. of water are required per ton of washed coal. The tail water usually contains all particles that pass through the 3/32-in. mesh, and is generally conveyed through a 6-in. wrought-iron pipe into the mine and flushed into the old workings.

Washery products are generally limited to the following sizes: Pea, buckwheat, rice and barley. The dimensions of the above sizes are:

Pea coal passed through $\frac{7}{8}$ in. and passed over $\frac{5}{8}$ in. mesh.
Buckwheat passed through $\frac{5}{8}$ in. and passed over $\frac{3}{8}$ in. mesh.
Rice passed through $\frac{3}{8}$ in. and passed over $\frac{3}{16}$ in. mesh.
Barley passed through $\frac{3}{16}$ in. and passed over $\frac{3}{32}$ in. mesh.

Cost of Production

Many ways of bringing the culm from the washery are employed. Steam shovels with a capacity of from 1 to 1½ cu.yd. are used with marked success. A trip of empty cars each having a capacity of two tons is brought to the steam shovel. Ten cars can be loaded in 10 min. and 5 min. is allowed for hauling and delivering the cars to the washery; 80 tons of culm are transported to the washery every hour by this method. The following is the labor charge against loading and transporting the culm to the washery:

2 engineers at $2.25	$ 5.00
2 helpers at $1.50	3.00
5 laborers at $1.50	7.50
Total	$15.50

The total amount of culm delivered in 9 hours is 720 tons; the marketable coal realized in 9 hours equals 500 tons; the boiler fuel secured in 9 hours equals 32 tons. The cost of operating the washery is as follows:

12 men averaging $1 56	$18.72
12 men and boys averaging $1.32	14.52
1 foreman at $3.00	3.00
Total	$36.24

To this must be added the cost of power, wear, and tear of the machinery, and 10 per cent. interest on the investment of $25,000, the total of which foots up to $15, or a grand total cost of production of $66.74, which equals $0.143 per ton of marketable coal produced. In some cases a few men have leased culm banks from the operators and sell most of their output to an operator or to railroad companies. The average price realized for the different sizes is as follows: Pea at $1.08 per ton; buckwheat, 70c. per ton; rice, 45c. per ton, and barley, 25c. per ton.

The average percentage of the different sizes is as follows:

Pea	23 per cent.
Buckwheat	38 per cent.
Rice	24 per cent.
Barley	15 per cent.
Total	100 per cent.

Upon the basis of a washery capacity of 468 tons as above mentioned:

108 tons of pea at $1.08	$116.64
178 tons of buckwheat at $0.70	124.60
112 tons of rice at $0 45	50.40
70 tons of barley at $0.25	17.50
Total	$309.14

From this income, the following royalty is paid to the lessor: Pea, 22.5c. per ton; buckwheat, 11.3c. per ton; rice, 5.6c. per ton, and barley, 5.6c. per ton. This makes the daily royalty paid the lessor on the above tonnage basis as follows:

108 tons of pea at $0.225	$ 24.30
178 tons of buckwheat at $0.113	20.11
112 tons of rice at $0.056	6.27
70 tons of barley at $0.056	3.92
Total royalty der day	$ 54.60
Cost of producing 468 tons	66.74
Total cost of producing 468 tons	$121.34
Market value of 468 tons	$309.14
Net profit on daily output	$187.80
Net profit per ton of production	0.4010
Cost per ton of production	0.2590

By taking 250 working days in a year, there appears a profit of $46,950; allowing $5000 per year for superintendency, etc., this leaves $41,950 as the profit on the plant worth $25,000, or 168 per cent. on the investment.

Conveying the Culm

A variety of methods are used in conveying the culm to the washeries throughout the anthracite field. At some plants the culm is flushed into a series of conveyers by water. These conveyers are usually from 100 to over 500 ft. long and are generally placed in series when more than two are used; one forms a permanent line at the washer end and the other is made so as to swing or extend as the supply of culm in the pile recedes. Each of the series of conveyers should be operated by a separate drive. The horsepower of each engine depends on the length, pitch and capacity of the line. For a line which does not exceed 500 or 600 ft., and with deliveries of from 80 to 90 tons per hour on a moderate pitch, a 50- to 60-h.p. drive is generally used.

The general arrangement of a conveyer is shown in Fig. 3. It consists of a wooden framework on which the conveyer runs. The troughs are made of cast iron, which has been found to wear better than rolled-sheet iron, besides costing about one-third less than the latter. The movable conveyer or swinging scraper is of more temporary design. The troughs are of the roll-sheet type, as they have been found somewhat lighter than cast iron bottoms and stand rough handling better.

Flushing a Culm Bank

These conveyers are usually fed with culm by means of water flushing of the material. The slush is caught in a steel chute, with an incline of 1 in 10, placed in the gulley; from two to three men are required at this end of the operation. Two of the men apply water to the bank by means of a hose as shown in Fig. 2, so that the slush moves readily; one other man is stationed with a pick along the trough to break up any large lumps that may attempt to run in the trough. This is especially necessary during the winter months. Water is delivered to the culm bank through an ordinary 2½-in. fire hose. The water pressure varies from 10 to 20 lb. per sq.in. The estimated amount of water used in flushing is approximately 375 gal. per ton.

Where a coal company operates a breaker, the steam is usually furnished by the main boiler plant, but in some instances, where the deposit of culm is remote from the main colliery, entirely separate boiler plants, usually consisting of two boilers of from 100 to 125 h.p. each, have been built. In some cases, old boilers from abandoned collieries have been installed. The cost of building such a washery does not often exceed $18,000.

The approximate daily output of clean coal varies from 300 to 500 tons, averaging about 400 tons per day; of this output, about 30 tons of rice and barley are used in the boiler, leaving 370 tons for marketable fuel. The total force employed numbers 29 men, which requires a daily wage expenditure of $49.85. The cost of fuel averages about $10.50, while $11 must be added to cover interest charges on the capital invested, and for wear and tear of the machinery. This makes the total cost of producing 370 tons, $69.35. The following is the price realized in the market:

92 tons pea at $1.08	$99.36
152 tons buckwheat at $0.70	106.40
81 tons rice at $0.45	36 45
45 tons barley at $0.25	11.25
370 tons total market value	$253.46
Labor charges	69.35
Royalty charges	42.92
Total charges	$112.27
Daily income from the operation	141.19
Cost per ton marketed	0.3034
Profit per ton marketed	0.3820

Power plants and manufactories in large cities are supplied with the washery output. It is this grade of anthracite that competes with the bituminous coal in the markets. The power station at Williamsbridge, which has a 32,000-h.p. capacity, burns annually 100,000 tons of coal, which is equivalent to the annual output of an average washery. All the combined elevated, surface and subway systems in New York and Brooklyn consume annually about 1,000,000 tons of fuel which is equivalent to the output of ten average washeries.

The production of anthracite washery coal in 1906 was 4,106,308 tons, of which 3,846,501 tons were marketed, 39,227 tons were locally consumed, while 220,590 tons were used in the fire rooms of the collieries. The amount of fuel thus shipped to market equaled 6.91 per cent. of the coal freshly mined during the same period. In 1905, the total washery shipments were 2,644,045 tons, which was equivalent to 4.87 per cent. of the freshly-mined coal shipped to market. The following table shows the shipments of washery output from 1890 to 1906 inclusive:

Year.	Tons.	Percentage of Washery, Out of Total Shipments of Anthracite Coal.
1906	3,846,501	6.91
1905	2,644,056	4.31
1904	2,800,466	4.31
1903	3,563,269	6.00
1902	1,959,466	6.28
1901	2,567,355	4.79
1900	2,059,309	4.57
1899	1,368,275	2.87
1898	1,099,019	2.62
1897	993,603	2.39
1896	895,042	2.07
1895	1,080,800	2.52
1894	634,116	1.53
1893	245,575	0.57
1892	90,495	0.22
1891	85,702	0.21
1890	41,800	0.11

One of the noticeable features in reclaiming the culm piles is the fact that no part of the bank is wasted. As has been previously stated, the particles passing through the 3/32-in. mesh and the refuse resulting from gigging are together conveyed through either a shaft or bore hole to the old workings, and thence along the gangways to the chambers, the lower ends of which are partitioned off with batteries; the culm fills up 90 per cent. of the open space in each chamber, and acting as a roof support, makes possible the future recovery of the coal remaining in the pillars.

The Peoples Coal Company of Scranton, Penn., has for the past three years made a practice of paying a bonus to its 600 employees. During the past 12 months, the sum paid out amounted to $20,000. This company operates the only non-union mine in the northern anthracite field, and was able to run its mines full time during the last strike, the daily output for this period often running as high as 1000 tons a day.

Explosive Effect of Electric Currents on Coal Dust

In a report on some recent experiments illustrative of the inflammability of mixtures of coal dust and air, presented to the North of England Institute of Mining and Mechanical Engineers, Phillips Bedson and Henry Widdas state that the inflammability of coal dust may be measured by means of an electric current. These experiments were made in a specially constructed apparatus; the coal-gas ignition flame was produced by a suspended coil of platinum wire.

Experiments carried out by Prof. W. M. Armstrong showed that the temperatures of the wire when heated by the current are as follows: A current of 10 amp. corresponded to 630 deg. C., 12 amp., to 700 deg. C., 15 amp., to 870 deg. C., and 17 amp. to 970 deg. C. In experiments using 1 g. (15.4 grains) of dust, the electric currents recorded in Table I were required to produce inflammation.

TABLE I. CURRENT IN AMPERES TO PRODUCE IGNITION.

Kind of Dust.	Current.
Brown coal	10.5
Bituminous coal	11.5
Cannel coal	12.5
Splint coal	17.0

Anthracite dust was tested up to a current of 17 amp., but no explosion was noted.

The dust was made by grinding the coal fine enough to pass through a No. 100 sieve, and the ground product used in Table I was simply air dried. Experiments on similar dusts which were artificially dried yielded the data in Table II.

TABLE II. CURRENT IN AMPERES PRODUCING IGNITION IN ARTIFICIALLY DRIED DUSTS.

Kind of Dust.	Current.
Brown coal	9.8 to 10.0
Bituminous coal	11.0 to 11.5
Cannel coal	11.5 to 12.6
Splint coal	13.0 to 15.0

Moisture In Dust Reduces Its Inflammability

It therefore appears that the artificial drying of the dust after grinding requires a lower electric current to cause an explosion. The influence of moisture in the dust was further tested by exposing the latter for a lengthened period to moist air. This was done by placing the dust in a shallow tray standing over water and covered by a bell-jar. Brown-coal dust after an exposure of 72 hours to moist air required a current of 12.2 amp. to explode it.

In another set of experiments, the freshly ground dust was made into a paste with water, and then allowed to dry by exposure to the atmosphere. In six days it was found to contain 3.1 per cent. of moisture. This dust required a 13.5-amp. current for its inflammation, whereas the freshly ground dust, not dampered, required a current of only 12.5 amperes.

The results of the experiments may be summarized as follows: (1) The dust of low-grade coal required less current to cause an explosion than the dust of a higher grade coal. The dust of brown coal exploded with a current of only 10.5 amp., whereas anthracite dust failed to explode when subjected to a current of 17 amp. (2) Moisture tends to prevent ignition. (3) Coal dust becomes less sensitive to ignition by lengthened exposure to air. A freshly ground dust was exploded by passing a current of 12.5 amp. through it, but after being exposed to the atmosphere for about three weeks, it required a current of 14 amp. to explode it. (4) It would follow from (3) that the dust on the haulage roads and airways in collieries, when previously dampened, is less dangerous than freshly made dusts in the working faces.

Dominion Coal Company

The report of the directors of the Dominion Coal Company, issued Feb. 27, gives the output of coal for 1907 as 3,541,253 tons, as compared with 3,552,746 tons in 1906. The total income was $2,094,539, as compared with $1,137,370 in 1906, the increase being due to the increased price paid by the Dominion Iron and Steel Company. The surplus amounts to $2,828,308. A new mine has been opened in the Lingan-Victoria district; the main slope has been driven 390 ft. and the back entry 335 ft.; the first levels have been broken off. The prospects are that the new colliery will produce a substantial output. The construction of a branch line seven miles in length connecting this district with the company's main line has been commenced. The report refers at length to the lawsuit with the Dominion Iron and Steel Company, but does not hold out much hope of an amicable settlement, stating that no genuine response has been made by the Steel company to overtures looking to a settlement on a reasonable basis; it is believed that the only alternative is to take the case to the Imperial Privy council.

The coal-mining industry of Japan is of ancient origin. There is evidence of the production of coal as early as the seventh or eighth century, and during the 15th century, many important mines were opened up, including those of Miike and Takashina in the Island of Kyuslu. In 1880, steam machinery for use in coal mines was first introduced into the country. In 1889 Japanese coal was first exported, in any considerable quantities, to foreign countries; the output has more than doubled since that time. Japanese coal is generally bituminous. The greater part of the seams belong to the Tertiary formation and none to the Carboniferous age.

Colliery Notes, Observations and Comments

Practical Hints Gathered from Experience and from the Study of Problems Peculiar to Bituminous and Anthracite Coal Mining

DEVELOPMENT AND MANAGEMENT

Diamond drilling at Le Roi properties in the Rossland district, British Columbia, during the year ending June 30, 1907, cost $2.79 per ft.; 4605 ft. were drilled.

In some English mines, which are not more than 900 ft. deep, salt, which has a dampening and beneficial effect, has been used with good results for laying the coal dust.

Every jig should be provided with the means for making adjustments and variations while the machine is in operation. It is not well, however, to change the adjustment too often, as poor work is frequently caused by such meddling.

Wherever it is necessary to withdraw timbers from the waste or abandoned parts of a mine, only competent persons should be employed. At least two men should be engaged for such work. They should first see that the surrounding roof is safe, and then begin operations at the far end and continue backward.

According to Williamson's "Mining Notes and Formulas," when fire-damp is mixed with:

3.5 times its volume of air it burns quietly.
5.5 times its volume of air it explodes slightly.
9.4 times its volume of air it explodes most violently.
13 times its volume of air it explodes feebly.
30 times its volume of air it shows plainly on a flame.
50 times its volume of air it can only be detected.

According to recently compiled figures, the coal industry is the most important in value, as compared with various other minerals produced in 1906. The comparisons are as follows: Coal $513,079,809; iron $505,700,000; copper $177,595,888; clay products, $161,032,722, oil and gas, $137,138,667; gold and silver, $32,630,200.

If good results are to be obtained in jigging, it is absolutely necessary to have a uniform layer of heavy material in the jig pan, for without this, the jig will not work properly. When starting a new jig, the cradle and slide gate should be closed until a good bottom is formed and then gradually opened until they are in their proper positions.

At collieries where it is dusty around the intake shaft, sprays fixed at the top of the shaft have been found effective in disposing of the dust. In frosty weather, when it is not advisable to have water running in the shaft, steam jets can be used, although they are not so effective as water. When treated in this manner, the dust is deposited in the sump instead of being carried into the haulage road by the air currents.

Some mine superintendents believe that there would be more prosecutions of miners for violations of the mine laws if the management had the power of offering the violators the choice of paying a fine, to be turned over to some charitable institution, or of appearing before a magistrate, as is done in Great Britain. It is believed that under these conditions foremen would enforce discipline more strictly and thus decrease accidents.

All mine props should be set so as to secure the largest area of roof possible and in such a manner that the pressure will be equal on all sides. In working places, the posts should not exceed the prescribed distance apart and may be even nearer if desired. Props should be set as soon as possible as the face advances. It has been shown that a good roof is often turned into a bad one by inefficient timbering, and it often requires more labor to put it in shape again than would have been required in keeping the place properly timbered.

In the coal mines of Great Britain, the use of any explosive is prohibited in the main haulage roads and in the intake airways unless all miners, except those engaged in firing the shot, have been withdrawn from the seam in which the shot is to be fired, and from all seams communicating with the shaft on the same level. It is further required that every part of the roof, floor, and sides of the main haulage road or intake within a distance of 60 ft. from the place where the shot is fired, be thoroughly wet, either naturally, or by the application of water.

Face conveyers for underground use have given good results when installed under suitable conditions, but coal seams in which they are adapted are few. The greatest difficulty exists in managing the roof weight. These conveyers should be light, so as to be easily moved and still sufficiently strong to withstand the rough usage often given underground machinery. Compressed air engines give better results than electric engines as driving power for such conveyers, as there is less vibration and the speed of the conveyer can be better controlled to suit the number of men working at the face.

The speed of a jig is largely dependent on the kind of material to be treated. In the anthracite coalfield, the speed varies from 130 to 150 r.p.m. When the coal comes into the jig regularly, the speed should be constant. For this reason the engine that drives the machine should be provided with a governor. When there is little or no material fed, the engine should be stopped, as there is a chance of disturbing the slate bottom. It is not well to keep a jig running when the breaker stops and the supply is cut off for any length of time, unless there is enough coal stored in the hopper.

When an explosive becomes fast in a newly drilled hole, it should be carefully removed and the hole stemmed up; another hole should be drilled in the same direction, but not nearer than 12 in. to the stemmed hole. If the direction of a shot is marked on the roof or other convenient place, the direction of the hole will be known, and if a misfire occurs, the drilling of the relieving hole into the charge of the missed shot can be avoided. In cases where shots misfire, accidents may be avoided if the place is fenced off for an hour and a danger signal put up. When the fence is removed, the detonator wire of the missed shot should be tied to a prop so that it may be recovered after firing the relieving hole.

The East India Railway Company of Bengal has a seam of coal 21 ft. thick. It is said to be one compact mass of hard coal without planes of division. The roof is of compact sandstone, from 100 to 160 ft. thick. The method of working this seam is mainly one of retreating. The necessary headings for haulage, ventilation, etc., are driven to the boundary before any coal is mined, except that produced in driving the headings which are arranged to form panels, 40 ft. wide and 206 ft. long. Starting from the boundary, the panels are cut into blocks 40 ft. square. All this preliminary development work is done in the bottom bench of the seam, the roads being 6 ft. high and 8 ft. wide. When a block 40 ft. square has been formed, the base is again cut up by driving two sets of roads at right angles to each other, each set consisting of 3 roads 6 ft. wide; this plan cuts the pillar base into a series of nobs about 6 ft. square. The top coal is well supported by timbering. Vertical cuts are made around the sides of the 40-ft. square block, and after the nobs are reduced to 5 ft., dynamite charges are placed in them. The timber is withdrawn, and the dynamite fired which shatters the nobs and drops all the coal below the sandstone roof. Falls are rare, but severe when they do occur. Ninety per cent. of the coal is recovered by this system of working.

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Contents

PAGE

Editorials:

Governmental Valuation of Mineral Resources 724
The Transaction in Yukon Gold..... 724
The Western Coal Situation..... 725
A Problem in Mining Finance..... 725
*Growth and Decay of the Mexican Plateau.....*Robert T. Hill* 681
A New Discovery of Bauxite in Georgia. *Otto Veatch* 688
*Stories of Batopilas Mines, Chihuahua. *Mark R. Lamb* 689
Giroux Consolidated Mines Company.... 691
*Map of Southwestern Chihuahua, Mexico.....*H. A. Horsfall* 692
Urique District, Chihuahua, Mexico..... 692
*Empire Building in Western Mexico. *Percy E. Barbour* 694
Petroleum Industry in Mexico..... 697
*Separation of Mixed Sulphides at Charcas, San Luis Potosi....*R. C. Canby* 698
The State of Sonora..... 699
The Mexican Miner.....*Allen H. Rogers* 700
The Dolcoath Tin Mine, Cornwall..... 702
*Present Cyanide Practice in Mexico. *Mark R. Lamb* 705
Mine Inspection in Mexico..... 709
*Cyanidation of Silver Ores at Guanajuato.....*Bernard MacDonald* 710
Patio Process..... 717
Conveying at the El Oro Mill, El Oro, Mexico 717
*Diamond Drilling at Mapimi. *J. F. Bennett* 718
Artificial Vein Formation...*R. E. Canby* 719
*The Treatment of Anthracite Culm Banks.....*Richard Lee* 720
Explosive Effect of Electric Currents on Coal Dust..... 722
Dominion Coal Company..... 722
Colliery Notes 723
Personal, Obituary, Societies and Technical Schools, Industrial, Trade Catalogs, Construction News..... 726
Special Correspondence..... 727
Mining News..... 729
Markets, etc..... 734
Prices Current Chemicals, Minerals, Rare Earths, etc..... 739
Dividends 740
The Mining Index..... 741

Illustrated.

Governmental Valuation of Mineral Resources

The prime function of the mining engineer, examining property, with or without the assistance of the mining geologist, is to determine the value of the property. In private, commercial work he is responsible only to his principals and to himself. Engineers and geologists in the employment of a government are responsible to the whole public, and recognizing both that responsibility and the inherent uncertainty respecting the valuation of resources that cannot be fully inspected, in general have wisely refrained from overstepping the bounds of purely scientific investigation. Consequently we are surprised to see among the recent publications of the Geological Survey of Canada, a report on "Gold Values in the Klondike High-level Gravels," by R. G. McConnell. This report is the result of a season's work carried on to estimate the recoverable gold remaining in the high-level gravels along Bonanza and Hunker creeks and a portion of the Klondike valley, and also to obtain as much information as possible in regard to the gold remaining in the low-level or creek gravel. In the summary of the work it is stated that the estimated past production of the Klondike is $95,750,000; while the estimated future output is $53,642,620. The resources of the various sections are estimated in detail.

It would be quite proper for a government to cause such a report to be made for its own information and guidance, but to permit its publication is dangerous, being likely to bring discredit upon the Geological Survey and also to mislead the public. It is the more surprising that such a report should have been allowed to issue in view of the manner of its preparation. In his letter of transmittal, Mr. McConnell states "The necessity of completing this work in a single season compelled us to make a somewhat hurried examination, but we were successful in covering the whole field in a fairly satisfactory manner." He was assisted during the season by a geologist and two topographers, and secured the services of certain "experienced and trustworthy miners" and also obtained assistance from the territorial mining engineer. This was a small organization to perform a work of such magnitude in so brief a time, but on the last page of the report it is stated "This estimate of the amount of recoverable gold remaining in the various Klondike creeks and benches is based * * * on sampling done by ourselves, and the results of actual mining operations and on information obtained from various miners, and is believed to be a reasonably close approximation. * * * While it is unlikely that any large area of gravel has escaped detection, minor discoveries may be expected as long as mining lasts and on this account any estimate is apt to be somewhat under rather than over the mark."

We are aware that geological surveys have made estimates of coal resources and iron resources, but we are unaware that any geological survey in modern times has attempted to make an estimate of resources so difficult to measure as are placer deposits of gold, until this effort of the Geological Survey of Canada. It will be dangerous if this report is established as a precedent; we hope sincerely that it will not be. The safety of national and state geological surveys lies in steering clear of commercialism and the functions of the professional men in private practice.

The Transaction in Yukon Gold

Especial point is given to the above matter by the spectacular transactions during the last week in the stock of the Yukon Gold Company. The only explanation why Mr. Lawson did not cite the estimate of the Canadian Geological Survey is that he did not know about it, but with a large distribution of the stock of the Yukon Gold Company a great many investors became financially interested in the Klondike, and if they are disappointed they are liekly to reflect upon the Survey. The Klondike and the property of the Yukon Gold Company are to a large extent synonymous terms. It happens that the estimate of Messrs. Beatty, Perry and Treadgold, of the staff of the Guggenheim Exploration Company, upward of $50,000,000 gross, is not very different from Mr. McConnell's $53,642,620. It is sincerely to be hoped that these enormous figures will be realized and also the net profit of $36,000,000, which Messrs. Beatty and Perry estimate.

Much surprise has been expressed that the Guggenheims should have departed

so far from their previous methods as to undertake to market 700,000 shares of the Yukon Gold Company with the aid of Thomas W. Lawson. As a matter of fact, they did not negotiate directly with Mr. Lawson, another party standing in between. Whether the Guggenheims knew just what was to be done is another matter. As for Mr. Lawson, he acted simply as salesman. Assuming that the stock was secured from the Guggenheims at $5, any advance realized over that price is the profit to be divided among those effecting the business, less, of course, the expenses among which is newspaper advertising that may have cost $100,000. This has been spoken of as a new way of selling stocks, but it is not so, inasmuch as it differs from the method commonly pursued in England only in that Mr. Lawson understands the art of advertising better than most people.

The Western Coal Situation

A temporary suspension of bituminous coal mining in the West, which will apparently be general throughout the Central Competitive States, began April 1. The word suspension is used advisedly, because there is none of the hard feeling usually involved in a strike. The miners will simply cease work until the wage scales are adjusted. In some of the districts, as in Indiana, this work has already been begun, and almost everywhere there are fair prospects of early settlement. In some districts—especially in Ohio and the Pittsburg district—operators will not be averse to a suspension of some weeks, which will enable them to work off accumulated stocks, and to start clear on new schedules. The wage scales, from all indications, will not be changed by any important amount, if they are changed at all. The miners have made no demand for an increase in the scale, the general expectation being that they will be entirely satisfied if the present rate is continued; and the operators, apparently, are not prepared to demand any reduction.

In the different States there is a different attitude apparent, but everywhere the miners are much better prepared for the discussion than the operators. Thus in Illinois there are serious differences among the latter, on points of the agreement, and it may take some time to reach a settlement. In Indiana, on the other hand, there is no difficulty; the scale has already been adopted in the block-coal district, and one will probably be formulated in a few days for the bituminous district, with little or no suspension of work. In Ohio it is probable that there will be more difficulty.

In the Western Pennsylvania district—to which is largely due the failure of a general conference—there has been a notable change of opinion. The operators are much more willing to come to a settlement than they were a short time ago.

In some of the less important districts, as in Michigan, there will be no cessation of work. In the Central Pennsylvania district—which ships to the seaboard chiefly—a scale has been agreed upon and put in force. In the Southwestern district, west of the Mississippi, the miners have agreed to continue work pending the adjustment of the scales now in progress in convention at Kansas City.

At many important consuming and distributing points there are considerable accumulations of coal, so that there is not likely to be any disturbance of business. Just how much time will be taken in formulating the new agreements is uncertain, but there is no reason now apparent why amicable adjustments cannot be reached.

A Problem in Mining Finance

In view of the manner in which the shares of the Yukon Gold Company are now figuring in the public eye, it is important to consider the prospects of that company. In its case the principles discussed in our recent editorial respecting Rand profits have a peculiarly pertinent bearing. The value of the gold in the Yukon property is estimated at $50,000,000; the net profit $36,000,000. For our present purpose we shall assume those figures without criticism, expressing no opinion as to their probability or the reverse. We assume, moreover, that the above figures represent all value—positive, probable and possible—although it is only fair to say that the Guggenheim engineers have in mind possibilities beyond the estimate. On the other hand engineers familiar with the Klondike are skeptical respecting the $36,000,000 net yield.

According to the recent report of the Guggenheim Exploration Company, its investment in the Yukon Gold Company was valued at $8,222,106. There are 3,500,000 shares in the company, wherefore at $5 per share the market valuation is $17,500,000. The Guggenheim Exploration Company expressed the opinion that the Yukon company would begin earning dividends before the end of 1908.

Now, let us see what investors in Yukon shares at $5 have to look forward to. On the basis of the above figures there is a possible profit of $18,500,000 if all of the gold could be extracted immediately, but of course that cannot be done and the actual profit will depend upon the time. If the time be 10 years, it may be figured that $17,500,000 at 5 per cent. compound interest would come to $28,505,750, wherefore there would be $7,494,250 to be divided in excess of what the capital could be made to earn in many sound investments. This would be about $2.14 per share, i.e., about 43 per cent. profit in 10 years.

Figuring another way: The annual sum required to net $1000 in 10 years at 5 per cent. interest is $79.50, i.e., out of the proceeds of each $5 share at least 40c. per annum should be set aside for amortization. Consequently a total of $10 per share in 10 years, or $1 per annum, would yield about 60c. net, or 12 per cent. on $5. Similarly, if the time were eight years the net yield would be 14.6 per cent.; if it were 15 years the net yield would be 8.8 per cent. On the bases of $7.50 per share and 10 years time the net yield would be 8 per cent.

No definite statements have been vouchsafed respecting the operation of the Yukon properties, but apparently it is not contemplated to exhaust them in less than 10 years, inasmuch as Mr. Treadgold refers to handling the low-grade gravel "after we have worked out the higher-grade ground in the first 12 or 15 years of our operations." In the above computations we have disregarded the profit of $2,000,000 which is expected from properties in British Columbia and California, but investors ought to be allowed something as a "sweetener." It is evident that if the estimates of gross and net yield are correct the Guggenheim Exploration Company may have a good investment on the basis of $8,222,106, but at $5 per share the public is paying about all that a mining property of proved ability as a going concern is worth under the most favorable circumstances. At any higher price the Yukon shares are obviously no great bargain. It is not exactly a case of getting two dollars for one.

Personal

Mining and metallurgical engineers are invited to keep THE ENGINEERING AND MINING JOURNAL informed of their movements and appointments.

J. A. Lewisohn, of New York, is visiting the various mining camps of Mexico.

E. A. Wiltsee, of New York, is in Guanajuato, Mexico, in the interest of the Pinguico Mining Company.

Mortimer A. Sears, of New York, is in Amelia county, Virginia, examining some mica and graphite properties.

Geo. A. Schroter, of Denver, Colo., is on an inspection trip to the Dolores mines, in western Chihuahua, Mexico.

J. R. Hastings, of Buffalo, N. Y., after a visit to look after mining interests at Central City, Colo., has returned East.

Henry Diedrick, of Virginia, Minn., is operating a diamond drill on an iron-ore deposit on Calm lake near Fort Frances, Ontario.

W. Roland Cox has returned to Chicago after an inspection of the mines of the Inde Gold Mining Company, Inde, Durango, Mexico.

John N. Northcutt, Marietta, Ga., president of the Morning Star Mining Company, Oaxaca, Mexico, has returned to the States after a visit to the mines.

C. A. Hood, of the Deister Concentrator Company, of Fort Wayne, Ind., and W. F. Deister are at Cobalt, Ont., for the purpose of introducing the Deister concentrating tables.

James C. Bennett, for two years past in charge of the departments of concentration and smelting machinery at the Risdon Iron and Locomotive Works, San Francisco, will retire from that position on May 1 next.

James H. Gardner, coal land expert of the U. S. Geological Survey, has been for several weeks in Socorro county, New Mexico, valuing and classifying the government coal lands in the Carthage district, with a view to their early restoration to public entry.

William Wurthenow, general superintendent of rolling mills for the Southern district of the Republic Iron and Steel Company, located at Birmingham, Ala., has resigned, effective April 1, to accept the position of general superintendent of the United Steel Company, at Canton, Ohio.

A. J. Collier, of the U. S. Geological Survey, has returned to Washington from a trip to Oklahoma, where he has been examining gold and silver claims on the national forest lands. The work has been done at the request of the Forest Service, the Survey geologist representing the interests of the claimants as well as those of the Government by making an impartial examination.

Obituary

F. G. Mayne, an English mining engineer, died suddenly in Philadelphia, March 24. He was on his way to London from Morganton, N. C., where he had been examining a gold property. He was 49 years old, and had had much experience in South Africa.

William Horace Holcomb, who died in Hinsdale, Ill., March 22, aged 70 years, was born in Tennessee, but had resided in Illinois for many years. At first a railroad man, he became interested in coal mining. He was president of the Star Coal Company and later of the General Wilmington Coal Company, of Illinois, and was interested in other coal companies. He was chairman of the joint interstate coal convention held in Chicago in 1898.

Societies and Technical Schools

The American Iron and Steel Institute—Articles of incorporation have been filed in New York of the American Iron and Steel Institute. The directors are all prominent men, including E. H. Gary, J. C. Maben, C. M. Schwab, William E. Corey, E. A. S. Clarke, W. J. Filbert, John H. Topping, Powell Stackhouse, E. C. Felton, Willis L. King, Edward Bailey, W. A. Rogers, J. F. Welborn, J. C. Drummond and Samuel Mather. The officers of the institute are E. H. Gary, president; Powell Stackhouse, first vice-president; C. M. Schwab, second vice-president; Willis L. King, third vice-president; W. J. Filbert, secretary and Edward Bailey, treasurer.

Among the purposes of the institute, as stated in the papers of incorporation, is "to afford means of communication between members of the iron and steel trades." In a published interview, Judge Gary, chairman of the United States Steel Corporation, and president of the new institute, said that the organization of the institute was not the outgrowth of the recent conferences regarding the steel trade position. As a matter of fact, he said, the purpose to form this institute dated much farther back than the recent conferences of steel men here. It was a mere coincidence, he said, that the members of the general advisory committee of the steel trade were interested in the institute. The institute would deal with all matters connected with the development of the steel and iron industries, and all men engaged in and prominently identified with the steel and iron trade will be eligible to membership. It will deal not only with the general economics of the iron and steel trade, but with the technical side of the industry as well. Its members will deal to some extent with the purely commercial side of the industry, as have the members of the advisory committee, but this will be merely incidental, it is said, to the broader scope of the institute's work.

Industrial

Hardy, Seligman & Co., of London, have been appointed agents for Thyssen & Co., machine engineers, of Mulheim-anden-Ruhr, Germany, for England and the Colonies.

The Lehigh Coal and Navigation Company has ordered 250 steel-underframe box cars from the American Car and Foundry Company, and 250 steel coal cars from the Columbia Steel Company.

The Wood Drill Works, Paterson, N. J., has issued a circular describing the use of its rock drills in the work on the Zuni Dam, New Mexico, which has just been completed by the Indian Bureau of the Department of the Interior. The work was done by Navajo Indians, superintended by white men.

The Asbestos Shingle, State and Sheathing Company, Ambler, Penn., is manufacturing fireproof building material compound of asbestos fiber and portland cement. Originating in Germany, this material is covered in this country by L. Hatschek's patent (Reissue No. 12,594, Jan. 15, 1907). It was designed in the first place for roof covering only, but its use has been extended to all classes of light constructive work. The material is furnished in a variety of forms, and besides incombustibility has the advantage of high insulating qualities, owing to its electrical resistance. The company issues a catalog, containing complete descriptions of its products, of which it is the only manufacturer.

Trade Catalogs

Receipt is acknowledged of the foling trade catalogs and circulars:

Scully Steel and Iron Company, Chicago, Ill. Stock List. Pp. 144, indexed, illustrated, paper, 4½x7 in.; March and April, 1908.

William Ainsworth & Sons, Denver, Colo. Catalog BX. Precision Engineering and Surveying Instruments. Pp. 64. illustrated, paper, 6x9½ in.; 1908.

Construction News

Sugar Loaf, Colorado—Manager W. R. Doty, Boulder, Colo., is arranging for the installation of a new hoisting plant.

Nederland, Colorado—Manager A. H. Kidney, of the Blue Bird property, has been East consulting with the owners as to the plans for new mine equipment and the erection of a 50-ton dry concentrating mill.

Special Correspondence from Mining Centers

News of the Industry Reported by Special Representatives at Salt Lake City, San Francisco, Toronto and London

REVIEWS OF IMPORTANT EVENTS

San Francisco

March 25—There is considerable activity in the matter of building dredges in districts outside of the proved ones, just at present, and more or less ground is being located for this purpose. The Yosemite Dredging and Gold Mining Company, in Mariposa county, has completed its dredge and is about commencing operations in the Merced river, near the county bridge on the Snelling road. Several hundred acres of land in the bed of the river have been purchased and options taken on other tracts. L. K. Vaughn is the local representative of the company. A new dredge, of the suction type, has been built in the San Joaquin river near Pollasky, Fresno county, where riparian rights have been purchased from the land-owners. Numbers of new mining claims have been located along the river above and below Pollasky. The Trinity Placer and Dredge Mining Company has located many claims along the Trinity river near Willow creek, some of the locations being in Trinity and some in Humboldt county. No dredge to work this ground has yet been built, however. A Du Bois dredge, of the suction type, has been built to operate on the American river, in Placer county, the first run of which, lately made, has been quite successful. Two more dredges of this type are to be put at work in the Sacramento river near Redding, Shasta county.

Dredge No. 6 of the Folsom Development Company, Folsom, Sacramento county, has just been completed by the Western Construction Company, and is ready for operations. The old dredge at Hawkinsville, near Yreka, is being dismantled and the machinery will be shipped to Idaho for use in that State.

The recent action of the Siskiyou county grand jury in recommending to the President the placing of certain sections of land within the lines of the Shasta forest reserve, has been approved by the officials of the range. This will bring within the reserve limits the town of Callahan, Siskiyou county, and the following mining towns in Trinity county: Carrville, Trinity Center, Dedrick, Integral, Helena, Coffee, Eastman, Minersville, Dorleska and Braydon.

It is reported in this city that the recent discovery of a very fine quality of petroleum in the vicinity of King City, Monterey county, has led the Standard Oil Company to bond about 100,000 acres of land at an average price of $7 per acre in that region. King City is on the northeastern side of the Salinas valley, near the foothills. If the report about the Standard is true, it will be something new for that company to purchase oil lands, which it has not hitherto done in this State.

For many years the old mining camp of Mooney Flat in Nevada county, close to the edge of Yuba county, and near Smartsville, has been lying idle, but some mining transactions of importance have recently occurred there. The latest is that by which J. A. Sorrell, of Wheatland has become interested in the Black Swan mine on the estate of the late John Rickey, and in addition to that has acquired considerable adjacent land. Development work will commence at once.

The famous old Morgan mine at Angels, Calaveras county, which has been closed down for over 25 years through litigation, may shortly be sold and started up again. The principal shareholders, James G. Fair and Wm. Irvine, are both dead and their heirs have settled the difficulties. Several rich pockets of gold were taken out before the litigation commenced. For example some $80,000 was recovered after one shot. The shaft and tunnel are caved.

There is now considerable activity at De Lamar, Shasta county, owing to the fact that the Bully Hill Mining Company is increasing the force of men at both the mine and smelter.

Salt Lake City

March 26—The Boston-Sunshine Gold Mining Company has been organized to operate the Sunshine mine in the Camp Floyd district, which was bought in under an execution something over a year ago. The mine is equipped with milling facilities which are to be improved along the lines in vogue at Mercur. A. W. Chesterton of Boston, is president of the new company; John Dern, of Salt Lake, vice-president and G. H. Dern, of Mercur, Utah, secretary and treasurer.

The extensive deposits of kaolin situated on the west side of Utah lake are to be utilized. Charles T. Hicks, president of the Hicks Clay Company, at Drake, Ill., is at the head of the enterprise and a company is in process of formation to develop the kaolin lands; also to erect a large porcelain and enamel brick and tile factory. The syndicate has acquired control by purchase and option of over 2000 acres of land.

Denver

March 29—In the Cripple Creek district, a preliminary run has been made on the dump plant of Stratton's Independence mill, and it is expected that it will start up in April for a continuous run. A high-grade concentrate has already been produced from the extremely low-grade dump ore, which is said to average only $3.60 per ton, while the first-grade concentrate ran about 14 oz. gold to the ton. The dry mill, treating mine ore, is not yet completed, considerable delay having occurred through non-arrival of some of the necessary equipment. It is now expected that this plant will be in operation about the middle of April, when the completed plant will be capable of treating 9000 tons per month of mine and dump ore. The dry mill is erected in two sections, the coarse crushing ore-breaker plant being erected practically at the collar of the shaft, whence the crushed ore is carried by belt conveyer to the fine crushing and roaster plant. The dump plant is being closely watched by those interested in the treatment of Cripple Creek ores; for if $3.60 ore can be profitably treated in the district, it will work a revolution in the mining and treatment of the low-grade ores of that camp. Although, through the present active competition between the cyanide and chlorination mills, ore under $8 per ton is now handled for $3.50 treatment charges, yet this charge it will be seen, practically amounts to the full value in Stratton's dump.

The drainage tunnel is now advanced about 1810 ft. from the portal, and the contractor states that at the present rate of progress, he expects to complete the work within 28 months from date. The general condition of the camp is extremely prosperous.

In the case of the Government against the Lost Bullion Spanish Mines Company, for fraudulent use of the mails, which was tried in August of last year, the promoters were given jail sentences, and fined various amounts. The case has now been appealed, and it is stated that the bill of exceptions now filed in the Federal Court covers 2300 typewritten pages. At stated in the JOURNAL of Dec. 7 last, at the trial a certain official of the United States Geological Survey testified that the alleged old Spanish mine workings were simply a limestone cave; on the other hand, two witnesses, said to be mining engineers, testified that there

was ore in sight to the value of many millions, and it now resolves itself into a question of veracity and ability, for the Government man's testimony was to the effect that the proposition was a fraudulent one, and the defendants now claim that their mines are as valuable as stated in the literature they sent through the mails, and that the Government witnesses were not sufficiently versed in mining to be able to give a correct opinion. The voluminous document filed in the Court of Appeals, citing 260 alleged errors of the trial judge, is more suggestive of sparring for points than a trial of the case on its merits. If the mine is as represented in the literature the company issued, the verdict that would appeal to the mining public would be the commencement of active mining, and shipment of 260 cars of pay ore, instead of exploiting 260 errors.

According to a press despatch from Telluride, Colo., Bulkeley Wells, formerly adjutant general of Colorado, narrowly escaped assassination at his home on March 28. A stick of dynamite or a bomb was exploded under or near his bed, tearing out the side of the house and shaking up and bruising the occupants. General Wells took a leading part in the suppression of violence during the labor troubles of 1904 and 1905, and was prominent in the prosecution of officers of the Western Federation of Miners at Boisé on the charge of complicity in the assassination of Ex-Governor Frank Steunenberg.

Indianapolis

March 30—The indications point to enough contention between the Indiana operators and miners over wage questions, which do not figure in an interstate contract, to keep a joint conference busy for several weeks. The operators have been called to meet with the miners in Terre Haute March 30, but it is generally known that the operators are not ready. The miners are determined in demanding several things which the operators will resist. One of these is more pay for the day laborer, who now receives $2.56 for inside work, for an eight-hour day. The operators say, taking machine and pick mining the State over, the miner will average $5 a day, which is about twice the pay of the day laborer. They also say statistics for 1907 will show that the day laborers in Indiana mines drew more money in proportion during the year than did the miners, but they worked more days.

The miners will ask for a reduction in the cost of blacksmithing and also for the striking out of the clause imposing a fine of $1 on a miner for each day he is on a stampede strike. The operators say that this is one of the last things they will surrender. The Indiana miners paid $1700 in such fines last year, but that amount does not adequately represent the repressive effect of the clause.

Notwithstanding President Lewis has sent out letters asking for the rehabilitation of the interstate agreement, the Indiana miners and operators will consider the Indiana situation as to local questions, which are now passed on in an interstate conference. President Van Horn, of the Indiana Miners' Association, has announced the scale committee, and the Operators' Association will name six operators and three State officers as their scale committee. There are sure to be some interesting developments in Indiana during April, but the strike scare has been dissipated because the miners do not advocate it.

Toronto

March 27—Cyril Knight, assistant geologist of the Ontario Bureau of Mines, has returned to Toronto from a trip of inspection to the new silver camp south of Lorraine township. The camp is situated about 16 miles southeast of Cobalt and 3 miles west of Lake Temiskaming. Mr. Knight found considerable snow on the ground, but judging from a few small outcrops the rock appeared to be of the Keewatin formation. Diabase is said to occur not far from the deposits and from experience at Cobalt, this is regarded as a favorable indication. The open cut on the Keeley property is from 40 to 50 ft. in length and 14 ft. deep in places on a vein from 2 to 6 in. wide, which carries wire silver. This feature is not characteristic of the Cobalt camp where native silver usually occurs in leaves or slabs. At the time of Mr. Knight's visit there were on this property 226 bags of ore ready for shipment, part of which had been forwarded to Lake Temiskaming.

On the location of the Haileybury Mining Company, the shaft was down about 40 ft. on a vein which, in some places, showed 6 or 7 in. of massive smaltite, but no native silver was visible. There were other smaltite veins in this locality which had not so far shown any native silver.

R. G. McConnell, of the Canadian Geological Survey, says, regarding the reported rich discoveries of gold in the Findlay river district, about 735 miles from Edmonton, Alberta, that there is no reason why gold should not occur in plenty in that region. There are numerous streams, and the rock formation, being of gneiss and schists, is favorable to the discovery of gold. The discoveries have caused considerable excitement in Edmonton, which will be the outfitting headquarters this spring. Some local men have already started for the district.

Premier Murray, of Nova Scotia, has introduced, in the provincial legislature, a measure to provide pensions for superannuated colliery workers. The bill creates one central relief society to undertake the work now done by individual societies at each colliery. It will be managed by a board which will also formulate a plan for old-age and total-disability pensions.

London

March 20—The report of the Transvaal Mining Industry Commission, appointed by General Botha's government, has recently been issued. There is a majority report, signed by four members, and a minority reported signed by the fifth member of the commission. The full report has not yet been received in London. From the cables it appears that the majority report recommends among other things the discontinuance of the recruiting of Kafir labor from Portugese territory and the abolition of the Pass law, the effort of which would be to curtail, if not entirely stop, the employment of native labor. The extinction of native labor and the employment of only white labor, however desirable in theory, is at present economically impossible, and there seems no danger of the Government adopting the recommendations. It is unfortunate that the question of white versus black labor, which has been exhaustively discussed in connection with the introduction of Chinese, should be again opened at the present time. The mining industry, on which the prosperity of the Transvaal is dependent, is now in a sounder position than it has ever been. Native labor is plentiful and profits commensurable with the capital invested are now being earned on many mines. If left undisturbed, there is every prospect of steady progress being made. The announcement, therefore, of the revolutionary proposals of the "all-white labor" party, which must tend to create a feeling of distrust and a fear of government interference in the present conditions, is to be regretted. While such proposals are under discussion, the flow of capital into the country which would legitimately afford increased employment for white labor will be curtailed.

The directors of the British South Africa Company did not receive sufficient support from their shareholders as regards the issue of fresh capital referred to in my last letter. A new scheme for raising further capital is now proposed.

The board has determined to create £1,750,000 in 5½ per cent. second mortgage debenture stock and to offer to the shareholders at par, *pro rata* to their holdings, £1,000,000 of such stock. The stockholder will have the right of converting his debenture into ordinary shares at par. That the directors consider the financial position of the company serious may be gathered from the terms of the following paragraph which their circular contains. "If these new proposals fail to receive response the position of the shareholders will be seriously prejudiced. The directors therefore trust that every shareholder will realize the gravity of the situation and apply for his proportion and for an additional allotment."

Mining News from All Parts of the World

New Enterprises, Installations of New Machinery, Development of Mines and Transfers of Property Reported by Special Correspondents

THE CURRENT HISTORY OF MINING

Alabama

BIBB COUNTY

Roden Coal Company—This company has placed orders for a quantity of machinery for the development of its property. The company's office is in Birmingham.

FRANKLIN COUNTY

A tract of 40 acres of brown iron-ore property has been sold to Auxford Brothers and G. W. Sigman, who have also taken a lease on 175 acres of the Faucett property adjoining. The purchasers will begin development at once, and will build a spur track from the railroad.

JACKSON COUNTY

North Alabama Coal Company—This company has made its first shipment of coal from its mines at Bryant.

TALLADEGA COUNTY

Alabama Marble Quarries—This is the name of a company organized to develop a marble deposit near Sycamore. The marble is reported as of fine quality, and especially suitable for interior work. Officers of the company are Dr. J. L. Gaston, Montgomery, Ala., president; H. L. McEldery, Talladega, vice-president; Louis B. Farley, treasurer; T. J. Scott, secretary, and J. Taylor Scott, general manager, all of Montgomery.

Alaska

DOUGLAS ISLAND

Alaska Treadwell—Some 700 miners, many of whom are foreigners, recently struck at this mine. They secured posession of a lot of dynamite, and their attitude was so threatening that a company of soldiers has been sent to the mine to preserve order.

Arizona

GRAHAM COUNTY

Detroit Copper Mining Company—This company has a new 5-in. pipe line which extends from the Gulch pump to the settling tanks at the foot of the mill, a distance of ¼ mile.

Black Diamond Copper Mining Company—This company closed its mine on March 16. It is expected that the mine will be reopened as soon as the company secures funds for carrying on operations, for only a month ago the company encountered a body of rich copper ore which promised good returns.

YAVAPAI COUNTY

Paymaster Group—This group of mines situated on the Hassayampa river 10 miles south of Prescott, is under bond to A. D. Lynn, who reports that he has uncovered a ledge several feet in width, carrying a pay streak 18 in. wide which assays high in gold.

Senator—This mine, situated 19 miles south of Prescott, and operated by Phelps, Dodge & Co., on March 15 suspended work, no reason being given for the suspension.

Tip Top—At this mine, situated 10 miles south of Crown King, again operated by the Tip Top Heath Company, a strike of high-grade silver ore is reported. The extent of the strike has not been determined.

Arkansas

DODD COUNTY

Iola Mining Company—This company will install another air compressor and several more drills at its zinc mine. Arrangements are also being made to put in an electric light plant.

California

BUTTE COUNTY

Big Butte—At this drift mine on Big Butte creek, the 60-ft. raise from the drain bedrock tunnel has encountered pay gravel adjacent to the old Taber works.

Carlisle—At this mine, Forbestown, adjoining the Gold Bank, considerable ore has been blocked out in the old workings, and a 10-stamp mill is in operation. A tunnel is being driven in new ground.

CALAVERAS COUNTY

Boston—Very rich gravel continues to be worked in this mine near Mokelumne hill, and numerous large nuggets are being taken out.

Chapman—New machinery is being installed on this gravel mine, and a new shaft is about to be started to strike the channel.

Ritter—The shaft of this mine, near Mountain ranch, is being sunk to 300 ft., and the rock being taken out is satisfactory.

EL DORADO COUNTY

Fowler—At this mine, Fort Hill, the rich ore shoot recently found continues to yield good ore.

Last Chance—At this property east of Nashville, Henry E. Smith superintendent, the 10-stamp mill is running regularly and has been equipped with concentrators.

IMPERIAL COUNTY

Picacho Basin Mining Company—It is expected that this company at Picacho will shortly install a milling plant of 500 tons daily capacity, and largely increase its force of men. J. B. Moody is general manager. The old mill of the California King Company will be dismantled and its place taken by the new one. Water will be piped from the Colorado river.

INYO COUNTY

Casa Diablo—This company's new mill, concentrators and cyanide plant, are now running steadily, after several short test runs. Additional cyanide tanks will shortly be put up, and another concentrator has been ordered. The company will soon have 50 men at work.

Schulthies—On this property, nine miles from Ballarat, the new stamp mill is in operation.

Ubehebe District—A. Farrington has bought a one-third interest in the Watterson-Smith lead property in this district. The Ubehebe Mines and Smelter Company in its tunnel is finding sulphide stringers carrying gold and silver. The Ulida company is teaming to the railroad high-grade copper-gold-silver ore.

Wild Rose Cañon—Sargent & Grundy, at Wild Rose, while working on their antimony property, have opened a quartz vein showing free gold.

KING COUNTY

Aurum Mining and Metallurgical Company—This company has been formed by S. P. McKnight, P. Byrne, W. A. Wickard and Geo. Gaylord to work claims at Fremont Peak, near Randsburg, and roads are being built to haul in machinery.

Colorado

CHAFFEE COUNTY

Granite Tunnel—This company has decided on immediate purchase of lumber and other supplies, and of machinery for pushing work on the new tunnel.

Turret—Operations have been resumed on this graphite mine, after a short suspension.

GUNNISON COUNTY

Pueblo Fuel Company—This company has begun the sinking of a two-compartment shaft on its property, near the coal breaker. A hoist is being installed.

OURAY COUNTY

Camp Bird, Ltd.—The statement for February shows that the mill ran 29 days, and crushed 6585 tons of ore, yielding 8090 oz. bullion and 497 tons concentrates. The bullion value was $128,295; concentrates, $18,645; total, $146,940. Expenses were $56,514, leaving a balance of $90,426. Development for the month was 678 ft. Construction expenses were $1384 for the month.

SAN JUAN COUNTY

Shipments of ore and concentrates from Silverton in February were 5275 tons. The larger shippers were the Gold King, 2300, and the Silver Lake, 1925 tons.

St. Paul Mining and Reduction Company—This company has been organized to reopen the St. Paul mine on Red mountain, and to extend the workings. Frank L. Ross and J. B. Ross, of Silverton, and George J. White, of Pittsburg, Penn., are the incorporators.

SAN MIGUEL COUNTY

Silver Pick—Operations have been resumed at this mine. Coal was carried in by pack train, to start the boilers.

SUMMIT COUNTY

Germania Tunnel—This property, on Little mountain is held by Louis Lipp under a lease and bond.

Mozart Tunnel—Arrangements are being made to install machinery to push work on this tunnel at Montezuma.

Indiana

Some English capitalists are in Indiana planning to develop the shale fields of the State on a large scale. They believe that the separation of oil from the Indiana shale will prove a profitable enterprise. "There is a bountiful deposit of black shale in Indiana," says State Geologist Blatchley, "and it contains much oil."

GREENE COUNTY

Superior—During the past two weeks the miners employed in this mine, near Linton, did not miss an hour's work, and in consequence the pay-roll was the largest in the history of the mine in the way of tonnage. The mine is 316 ft. deep, and hoisting the coal is a big job.

Kansas

ZINC-LEAD DISTRICT

Big Chief—This company has bought the Ayers-Sloan mill from Robert McCreery, and will move the outfit to its own property near Baxter.

Shomon Lease—On this lease, near Playter, George Hornung has struck a 16-ft. face of ore, and has two shafts and five drill-holes in the ore.

Michigan

COPPER

Winona—Shaft No. 3 is being sunk below the 11th level and a crosscut has been extended to the lode and drifting, north and south, has commenced; average copper-bearing rock is showing. Drifts north and south from the 9th and 10th levels are showing good copper and the formation is uniform, particularly so to the south. No. 4 shaft, which is located 1650 ft. to the southwest of No. 3 and about 400 ft. from the King Philip boundary line, is bottomed at the 7th level and crosscuts are being extended from the 5th, 6th and 7th levels to the lode. Both shafts have three compartments including two skipways. No. 4 shaft is to be equipped with a 3-phase, 2300-volt electric hoisting plant of approximately 2000 ft. capacity. The induction motors are to be geared to the existing drums.

Isle Royale—Sinking is going on in all the shafts on this property, with the exception of No. 6, which is being enlarged to take in two skipways. This work will be finished in a short time and sinking will be resumed and drifts will be started when each level is reached. No. 2 shaft, the principal producer, is sinking below the 24th level and from the 18th to the 23d levels inclusive, drifts are being extended north and south. At the upper levels drifts south have gone as close as possible to the old Huron workings. At No. 4 shaft preparations are being made to begin drifting at the first level, 138 ft. from surface. The temporary surface equipment has been completed and is now ready for service. A spur has been run to the shaft-site and work underground will be pushed. No. 5 shaft is sinking to the 2d level at a depth of 260 ft. Work on the temporary surface plant is progressing favorably and will soon be put in commission. The permanent surface equipment for No. 6 shaft has been started and the coming summer will see the completion of a new boiler, engine and steel rock house. Diamond drilling is being carried on at the Hussey-Howe tract and some encouraging cores have been taken out.

Ojibway—Sinking is being pushed in both shafts; No. 2 is down 325 ft. and No. 1 170 ft. At a depth of 350 ft. a crosscut will be started to cut the lode which is about 40 ft. to the west. The foundation for the hoisting plant at No. 2 shaft has been completed and the machinery will soon be on the ground.

Toltec—Diamond drilling has been started on Section 4 of this property, which adjoins the Adventure, with the expectation of opening the same formation which was disclosed at the Lake property.

Hancock—At a depth of 730 ft., No. 2 shaft has encountered an amygdaloid formation showing good copper. This comes as a surprise as the known lodes, traversing this tract, are expected to be cut at a depth of approximately 2000 ft.; consequently the identity of this find has not yet been established. This shaft was started on Dec. 12, 1906, but, owing to the character of the ground, which was mostly broken conglomerate and sandstone, sinking was very slow. With a more settled condition and better hoisting facilities greater progress will be made from now on.

Missouri

ZINC-LEAD DISTRICT

Barber-Gregg Land—Donahue & Jenkins have struck zinc ore in several drill-holes on their lease on this land at Tipton Ford.

Bullfrog—This company is putting down several drill-holes north of its mine, to determine the extent of the orebody in that direction.

Carl Junction—William Lockner has sold 40 acres of mining land for $10,000 to H. L. Kramer.

Dorn Land—A tract of this land in Jasper county has been sold by D. D. Dorn for $10,000 to W. B. Widener.

Duplex—In its Cornbelt mine this company has worked a drift under and through the right of way of the Frisco railway. The railroad company will take legal action to see if it can close the drift.

Gorman Syndicate—This company has sold its 40-acre lease southeast of Carterville for $12,500. The New York Union Mining Company is the purchaser.

Little Princess—This mine at Webb City is working a full force, although it has 800 tons of jack in the bins, held for better prices.

Montana

BUTTE DISTRICT

Davis-Daly—Capt. C. H. Palmer, general manager of this company, reports that about 90 ft. have been driven across the newly discovered vein in the south crosscut on the 1000-ft. level, and the hanging wall has not yet been reached; the ore zone, however, has been passed. A crosscut has been started on the 800 for the purpose of opening the vein on that level. During the last month a total of 546 ft. has been driven in three openings on the Colorado. Developments on this property are encouraging.

Butte-Balaklava—The shaft is going down at a rapid rate and it is expected that the crosscutting on the 700 will be commenced early in April. At a distance of about 20 ft. north of the shaft the Edith May vein, in which the North Butte company is mining, will be intersected. It is proposed to extend the crosscut on the

700 through the four known veins on the property. The new electrical equipment, which has been in operation for the past month, consists of a double-drum hoist capable of sinking to a depth of 2500 ft., and a compressor for furnishing air to the drills and to the pump on the 500-ft. level. An electrical pump will be installed at the 700-ft. station, and an order has been placed for a second compressor similar in capacity to the one now in operation.

LEWIS & CLARK COUNTY

Helena—Announcement has been made that the patents for the Baker & Burwell electrical process for the treatment of ore have been transferred to the Montana Metallurgical Company, of Helena, a holding company which will act through operating companies; also that plans have been perfected for the erection at Helena or East Helena this summer of a plant with a capacity of from 100 to 150 tons of ore per day.

MADISON COUNTY

Conrey Dredging Company—This company, operating in the Ruby valley, at the mouth of Alder gulch, has changed the equipment on two of its dredges from steam to electricity. There are now two dredges which have a capacity of 100,000 cu.yd. of earth every month; the largest one has handled 115,000 cu.yd. of earth during nearly every month it has been in operation for the last two years.

Boaz Group—The management of this property, in the Red Bluff district, is making preparations for a busy season. New machinery is now on the ground and will be installed within a short time. A shaft house is being erected and other necessary work will be done before actual operations are begun, which, it is expected, will be about May 1.

Nevada

ESMERALDA COUNTY—GOLDFIELD

Ore Shipments—Shipments for the week ended March 19 are reported as follows: To Western Ore Purchasing Company, from Florence Annex, 85 tons; Rogers-Syndicate 117; total 202 tons. To Nevada Goldfield Reduction Works, from Little Florence, 60 tons; Jumbo, 295; Rogers-Syndicate, 165; Mohawk, 260; Daisy, 35; Western Reduction Company, 42; El Dorado, 30; total, 887 tons. Kinkead mill, 100 tons; Combination, 650 tons. Total production reported, 1839 tons.

Kinkead Mill—John S. Cook & Co., owners of the Kinkead mill on Columbia mountain, have leased the property for a term of 18 years to Jacobs, Raven & Wedekind. The lessees have already taken charge of the mill and have made their initial run on a lot of ore from the Kendall mine. The Kinkead is equipped with mills of the Kinkead type and a cyaniding plant.

Warner-Stewart—This company, holding the Rosebud lease on the Goldfield Consolidated, has installed an air compressor and other machinery.

NYE COUNTY—MANHATTAN

Rogers-Foreman Lease—In this lease on the Earl ground a narrow vein of rich ore has been struck. It is said to be from 1 to 3 ft. wide, and has been uncovered for about 100 ft. in length.

Thanksgiving—In this mine, which has been a steady producer of low-grade ore for some time, a rich streak was recently uncovered, which is reported to carry very high values.

NYE COUNTY—TONOPAH

Ore Shipments—Shipments to smelters over the Tonopah & Goldfield Railroad for the week ended March 19 were: MacNamara, 105; Tonopah Extension, 53; total 158 tons. Shipments to mills were: Tonopah Company, 1380; Montana Tonopah, 1100; Belmont, 490; Jim Butler, 380; Midway, 180; total 3530 tons. This makes a total of 3688 tons for the week.

Belmont—This company has been changing over its mill to take power from the Bishop power line. This made a stop of several days necessary. The power plant at Millers will probably be shut down.

Jim Butler—The management has decided to concentrate work and to push development on the Stone Cabin claim.

Midway—The principal development work is now being carried on between the 835 and 1035-ft. levels. It continues to show well in milling ore, with some shipping ore.

MacNamara—A new orebody is reported found in a drift on the 300-ft. level, 640 ft. from the main shaft. It is shipping ore, and the extent has not yet been determined.

WHITE PINE COUNTY

A rush has developed to the Granite district 30 miles north of Ely. The district is not new, having several properties at work; but a recent reported find of high-grade ore started the excitement.

Boston Ely—The shaft on this property is now down 700 ft. Drifting will soon be begun on the lowest level.

Ely Rochelle—Work is going on steadily on this property, which adjoins the Giroux. Drifts from the 180-ft. level are in low-grade copper ore.

Ely Bonanza—Work is progressing on this mine, which is controlled by Martin & Sherrerd of Scranton, Penn. Sinking has reached the 400 level. A short distance below the 300 level low-grade copper was entered, in which the shaft has since continued.

New Mexico

GRANT COUNTY

The new gold finds in the Hachita mountains are attracting wide attention, particularly to the Eureka district. The gold occurs both as placer gold and in fissure veins. On Sunny Slope mountain placer gold as flakes and nuggets is panned by the use of water taken mostly from the bottoms of shafts found in the vicinity and is vanned out dry with ease in many places. People from the neighboring towns, and from the mining sections of Arizona are rapidly staking the country.

SOCORRO COUNTY

Mocking Bird—This property, operating on lead, zinc, copper ores, is to be equipped with a smelter in the near future; the plans have been completed and orders for the machinery have been placed. The 200-ft. shaft and four levels are in good ore. The property is in the San Andreas mountains, about seven miles from the H. Newman ranch.

Germany Mining Company—This company, of Magdalena, has completed a four months' campaign of development, with 847 ft. of tunnel work. C. T. Brown, the general manager, gives the cost of these prospect adits as $6.01 per foot, including excavation, supplies, transportation, labor and management, and general expenses. The record speed for the camp, 111 ft. of single track tunnel, was made in 60 shifts. The company is developing a zinc-lead property.

DONA ANA COUNTY

Picacho Paint and Mining Company—This company, of Las Cruces, has been organized to manufacture paint from the products of mines owned by the incorporators in various parts of the Territory.

Ohio

The total coal production for the year is reported at 27,213,495 short tons in 1906, and 32,465,949 in 1907; an increase of 5,252,454 tons, or 19.3 per cent. The production for 1907 was the largest ever reported.

Oklahoma

OTTAWA COUNTY

At Miami, the Emma Gordon, New State and old Chief mills are completed. The owners are pumping out the water from their zinc mines in preparation for starting up.

Pennsylvania

The total coal production of Pennsylvania, as summed up from the district inspectors' reports for the year, was as follows, comparison being made with the

Bureau of Mines' report for the preceding year; the figures are in short tons:

	1906.	1907.	Changes.
Anthracite.....	72,139,566	86,279,719	I. 14,140,153
Bituminous....	129,532,991	149,759,089	I. 20,226,098
Total.....	201,672,557	236,038,808	I. 34,366,251

The total increase was 17 per cent. The production was a little over one-half of the total for the United States.

ANTHRACITE COAL

Lehigh Coal and Navigation Company—This company will issue $1,734,500 in new stock, the proceeds to be used in paying for the extensive improvements now in progress on the company's coal property. Stockholders have the right to take the new stock at par, to the extent of 10 per cent. of their present holdings.

Philadelphia & Reading Coal and Iron Company—This company's statement for February and the eight months of its fiscal year from July 1 to Feb. 29 is as follows:

	February.	Eight Mos.
Earnings.....	$2,659,582	$26,804,081
Expenses.....	2,560,181	24,701,830
Net earnings.....	$ 99,401	$ 2,102,251

For the eight months there were increases of $1,477,232 in gross earnings; of $781,026 in expenses; and of $696,206 in net earnings.

South Carolina

YORK COUNTY

Clawson Gold Mining Company—The machinery for this mine at Fort Mill has been shipped from Charlotte, and will be in operation in April. T. W. Clawson is secretary and treasurer.

South Dakota

CUSTER COUNTY

Mariposa—Good free-milling ore has been opened with the use of another power drill and Superintendent Wise is continuing work in the drifts with a larger force of miners.

LAWRENCE COUNTY

Gilt-Edge-Maid—A new hoist will probably be decided upon shortly. The mill is now handling 200 tons daily of $2 ore taken from the open cut and found in the vertical porphyry formation.

Globe—The three months' contract with the Superior Chemical Company which gave the latter control of the Globe new 200-ton mill for test purposes has expired and the Globe company is now making regular runs.

Homestake—Sinking is again to be started at once in the Star shaft, which has been re-timbered and straightened. It will be continued to the 1250-ft. level, where more drifting will be done. The Star is one of the old and important shafts of the company.

Imperial—The Dakota shaft has finally penetrated the lower contact and has reached quartzite at a depth of nearly 600 ft. This is important to the Baldwin mountain district.

Monarch—George Bachman has completed renovations in the old mill and is about ready to start up with electric power. He is handling a supply of high-grade ore that was formerly treated by smelters outside.

Superior Chemical—New officers were chosen at the annual meeting as follows: President, Dr. J. A. Ogden, Deadwood; secretary, F. W. Bower, Deadwood; treasurer, H. H. McAdoo, Hamburg, Ia. The same men compose the directorate. The company owns an electro-chemical mill process invented by Doctor Ogden.

PENNINGTON COUNTY

Golden West—Sinking will be resumed in a few days in the new shaft, as the new machinery is set and development can continue while the changes are being made in the treatment plant.

Grand View—An electrical-power plant is being installed, so that the property may be reopened by the Richards interests in a few weeks. The five-stamp concentration plant will treat the ore, which contains gold, silver, lead and antimony.

Utah

SALT LAKE COUNTY

Yampa Smelter—Good headway is being made with construction work on the converter department, which is expected to be ready for operation some time in June next.

SUMMIT COUNTY

Ontario Drain Adit—The water level has fallen to a point 25 ft. below the 1300 level of the Ontario mine. It is being drawn off through 10 drill holes put in from a parallel drift to the main adit. Other holes are being drilled and there is every indication that the great avenue will be cleared of obstructions in May, after having been closed for three years and three months.

TOOELE COUNTY

Consolidated Mercur—Recent developments made in the Golden Gate property of this company are important, adding many years supply to the reserves. The ore is oxidized and contains values of from $2 to $30 a ton. It requires no roasting, and hence can be handled cheaply.

Honerine—The properties of this company at Stockton will soon be sold under execution to satisfy creditors.

Wisconsin

ZINC-LEAD DISTRICT

Best—The new calciner building is inclosed and machinery is being installed at this property; mine work will be resumed the first part of April. About 800 tons of concentrates are ready for roasting.

Dall—This mine is being pumped out and work will be resumed in April. Hereafter shovelers and trammers will be paid by the can instead of a flat day wage as heretofore. The can system has come into favor since the first of the year, and is likely to be adopted soon in every mine where circumstances are favorable.

Frontier—This mine is turning out 100 tons of zinc ore and 6 tons of lead concentrates weekly with its new 100-ton mill; the zinc product is above the average grade and will not be roasted. The property has railroad facilities and is equipped to mine at low cost per ton. Track scales have just been installed.

Jarrett—This company is building a 100-ton concentrator.

St. Rose—Since resuming operations a month ago, the main ore sheet in this mine has increased from 1 to 3 ft. in thickness. The St. Rose is one of the oldest producers in the Platteville camp; it is one of the very few mines in the district where electric rock drills have been successful. A Temple electric air drill, installed a short time ago, is also making a good record.

Wyoming

CARBON COUNTY

Union Pacific Coal Company—Mine No. 1 of this company at Hanna was closed down March 21 on account of fire which started on the tenth level. On March 28 a party entered the mine to see what measures could be taken to extinguish the fire. Some hours later there was a violent explosion, which caused a caving of the entrances to the mine. How much damage was done underground is unknown. All those in the mine were killed, including Superintendent Alexander Briggs, three foremen and 16 miners. A number of men attempted to enter the mine after the accident, when a second explosion occurred, killing nearly 50 more miners.

Canada

ONTARIO—COBALT DISTRICT

Ore Shipments—Shipments of ore for the week ending March 21 were as follows: Buffalo, 65,700 lb.; Kerr Lake (Jacobs), 63,080; La Rose, 140,000; Nipissing, 63,230; Nancy Helen, 80,420; O'Brien, 252,410; Silver Queen, 60,000; Townsite, 40,000; Trethewey, 61,420; total, 826,260 pounds.

Coniagas—The main shaft is being timbered and a large new shaft-house, 85 ft. high, is being erected. The ore from all underground workings will be hoisted at this shaft. Four new Deister tables are in operation in the mill.

Provincial—At this mine, from which the first shipment was recently made to the Deloro smelter, 25 men are at work in charge of E. T. Corkill, provincial inspector of mines. The shaft has a depth of 140 ft. The first level is at 65 ft., at which point 450 ft. of drifting has been done. The second level is at 125 ft., with about 100 ft. of drifting. In addition to the 25 tons already shipped nearly 50 tons of ore have been taken out.

Silver Queen—A nugget 14 in. thick and weighing about 1000 lb. has been take out of the main shaft at the 125-ft. level. The company is preparing to install a new plant at a cost of $10,000.

Victoria—A force of 60 men is at work under Captain John Harris, formerly with the McKinley-Darragh and La Rose mines. The main shaft is down 150 ft., at which level a crosscut has been driven for 50 ft., where a good showing was encountered.

ONTARIO—PORT ARTHUR DISTRICT

Beaver—A 100-stamp mill is being installed on this property by A. E. Hogue, mining engineer.

NOVA SCOTIA

Nova Scotia Steel and Iron Company—At the annual meeting, held March 25, President Robert E. Harris said, regarding the question of ore supply, that the slopes to the submarine iron-ore deposits at Wabana, Newfoundland, were working in ore at a distance of more than 2200 ft., from the shore. A new air compressor was installed. The progress during the year had been satisfactory and he anticipated that the company would be able to mine ore from three submarine areas early in 1909.

Mexico

CHIHUAHUA

Picachos—Henry Faivre continues to ship several carloads a month of 50 per cent. zinc ore from his property near Picachos, being the only one in that section who has not been frightened into closing down because of low prices.

Republica—This property in the western part of the State of Chihuahua has greatly increased its shipments, having sent out during the first half of March 50 tons of 1000-oz. concentrates to El Paso, while the tailings which run about 65 oz. silver are stored for treatment in the cyanide tanks which are being erected.

Southern Mining Company—This company, operating the Santa Margarita mine in the Ocampa district, has the machinery on the grounds for the 5-stamp mill which is being erected, and a large quantity of good ore is being developed.

Chihuahua Mining Company — This company's properties in Santa Eulalia, as well as those of the Potosi Mining Company, are still operated as before the reported sale to Chas. M. Schwab and associates, indicating that this deal has not yet been consummated.

DURANGO

Velardena—Activity is increasing at the mines of this district. It is reported that the American Smelter Securities Company will employ between 2000 and 3000 men and that the capacity of the smeltery will be increased by the addition of new furnaces.

FEDERAL DISTRICT

Nondalco Refinery—This gold and silver electrolytic refining plant in Mexico City, which was sold by the National Metal Company to the new French company, it is stated will, because of the great increase in the receipts of bullion, continue in commission even after the completion of the new plant in Santa Maria which is to have twice the capacity of the old plant and to be ready in July.

GUANAJUATO

El Cubo Mining and Milling Company—This company has begun the extension of its 6000-ft. adit into the mountain to connect with the Villalpando shaft, which will be unwatered. The shaft has been full of water many years.

La Luz—According to an officer of the company a stamp mill is to be built at a cost of $2,000,000.

La Pinguica—These tin lands, covering about 20,000 acres, have been obtained through Dwight Furness under option by C C. Douglas and associates of Houghton, Mich., who have agreed to spend $50,000 Mexican in development work.

Bolañitas—This property, together with the Refugio and La Luz, is to be used as the foundation for a several-million-dollar company.

GUERRERO

Columna y Anexas Mining Company—This company, holding ground in the famous old camp of Taxco, has completed its 25-ton concentrating and cyanide mill, and expects to have it in operation early in April.

JALISCO

Mina Grande—This property in the Hostotipaquilla district, on the Santiago river, has been taken under option from Dwight Furness, of Guanajuato, for $75,000 gold by the Mexican Agency, Ltd., of London.

El Favor—This mine in the Hostotipaquilla district, controlled by the Makeever Brothers, of New York, and under the management of Patrick Fitzgerald, has been examined by George F. Milliken, of New York, and he recommends the erection of a 500-ton mill. The property was acquired about two years ago from Carlos Romero, of Etzatlan, and a little development work by Frank G. Stevens, the then manager, soon opened up large bodies of ore on what is believed to be a continuation of the famous old Mololoa vein of Hostotipaquilla.

Securities Corporation—This company, with a capital of $1,000,000 and property near Guadalajara, is contemplating the construction of 36 miles of railroad to connect with the Mexican Central and the erection of a smelter in Guadalajara.

Europe

RUSSIA

A preliminary statement of coal output in 1907 shows: Anthracite, 2,001,700 metric tons; bituminous, 14,700,230; total, 16,701,930 tons, an increase of 1,817,730 tons over 1906. The coke made was 1,734,000 tons, an increase of 184,500 tons.

Africa

WEST AFRICA

The gold production of West Africa for the year, as officially reported by the secretary of the Gold Coast Colony, was 210,047 oz. bullion in 1906, and 276,897 oz. in 1907; an increase of 66,850 oz. The bullion reported in 1907 was equal to $5,662,040, or 273,462 oz. fine gold.

NATAL

The coal production of the colony in January was 130,815 tons; of which 67,533 tons were exported, and 62,148 tons sold to steamships in the port of Durban.

TRANSVAAL

Coal production in January was 348,600 tons, from 127 shafts or openings. The average price of coal sold was $1.26 per ton at the colliery.

The labor report for January shows that 17,970 natives arrived during the month and 10,329 left the mines; an increase of 7641, making 125,845 employed Jan. 31. There was a decrease of 3074 Chinese, leaving 28,406 at the end of the month.

New Zealand

Exports of gold from New Zealand for the full year are reported by the Mines Department at 563,843 oz. bullion in 1906, and 508,210 oz. in 1907; a decrease of 55,633 oz. The exports of gold and silver, bullion being reduced to fine gold, were as follows, in ounces:

	1906.	1907.	Changes.
Gold	534,675	477,364	D. 57,311
Silver	1,390,536	1,562,603	I. 172,067

The equivalent value of the gold was $11,051,733 in 1906, and $9,867,118 in 1907. New Zealand has no silver mines, the silver being won in connection with gold, chiefly from the mines in the Hauraki district. The decrease in gold was 10.7 per cent.; the increase in silver, 12.4 per cent.

Metal, Mineral, Coal and Stock Markets

Current Prices, Market Conditions and Commercial Statistics of the Metals, Minerals and Mining Stocks

QUOTATIONS FROM IMPORTANT CENTERS

Coal Trade Review

New York, April 1—In the West all interest is centered in the suspension of mining which begins today. There is no reason to believe that this will continue long. In fact, it is not universal, and settlements are well advanced in many districts. Comments on the situation will be found on the editorial page.

At a joint conference held at Clearfield, last week, by the operators and miners of the Central Pennsylvania soft-coal field the present wage scale was adopted for another year from April 1. The conference was harmonious and no friction whatever was encountered in arriving at an agreement. The Central field has always had its own contract, and does not come under the Western agreement. Its coal goes to Eastern points and the Seaboard chiefly.

The trade in the East is generally quiet, and there has been little or no change in either anthracite or bituminous coal.

Coal Traffic Notes

Tonnage originating on Pennsylvania railroad lines east of Pittsburg and Erie, year to March 21, in short tons:

	1907.	1908.	Changes.
Anthracite	1,188,087	1,138,464	D. 49,623
Bituminous	8,353,763	7,278,297	D. 1,075,466
Coke	3,120,047	1,588,092	D. 1,531,955
Total	12,661,897	10,004,853	D. 2,657,044

Total decrease this year was 21 per cent.; decrease in coke, 49.1 per cent.

Anthracite coal tonnage of Lehigh & Susquehanna railroad—operated by Central Railroad Company of New Jersey—full year, long tons:

Receipts:	1906.	1907.	Changes.
Wyoming Region	4,128,633	4,981,364	I. 852,731
Upper Lehigh	237,402	308,211	I. 70,809
Beaver Meadow	624,386	698,733	I. 74,347
Beaver Brook	78,475	78,161	D. 314
Mauch Chunk	2,068,409	2,525,747	I. 457,338
Schuylkill	58,360	165,100	I. 106,740
Total	7,195,665	8,757,316	I. 1,561,651
Deliveries:			
East of M. Chunk, rail	6,809,762	8,325,071	I. 1,515,309
East of M. Chunk, canal	137,525	184,533	I. 47,008
On line above M. Chunk	206,569	208,086	I. 1,517
Conn. lines above Mauch Chunk	41,809	39,626	D. 2,183
Total	7,195,665	8,757,316	I. 1,561,651

The average earnings of the railroad per ton carried were 58.72c. in 1906, and 60.54c. last year.

The Bureau of Statistics reports the coal sold to steamships in 1907 at all United States ports as follows, in long tons:

	Constwise.	Foreign.	Total.
Atlantic ports	2,207,543	4,906,781	7,114,224
Gulf ports	98,434	586,225	684,659
Pacific ports	675,021	261,270	936,291
G. Lakes, bituminous	.....	.....	2,564,471
G. Lakes, anthracite	.....	.....	6,319
Total	2,980,998	5,754,176	11,305,964

The report for the Great Lakes does not separate coal sold to foreign vessels. The total in 1906 was 10,295,995 tons; showing an increase last year of 1,009,969 tons, or 9.8 per cent.

New York

Anthracite

April 1—After today it is expected that prepared sizes will be in more demand. The small steam sizes are in fair demand and are inclined to be short. Prices are held firm, although certain outside dealers continue to make slight reductions for both prepared and small steam coal; these concessions are made only on slightly inferior grades of coal. Stocks are not large and the mines are still operating four days each week. At the time of going to press the 50c. April discount has not been announced. Prices, therefore, are quoted as follows: Broken, $4.75; egg, stove and chestnut, $5; pea, $3.25@3.50; buckwheat No. 1, $2.75@3; buckwheat No. 2 or rice, $2.15@2.25; barley, $1.75; all f.o.b. New York harbor.

Bituminous

Contracts have been coming in more freely and some companies report that the bulk of their output has been contracted for. This applies not only to the best grades, but also to some of the poorer coal. Business throughout the country shows very little life, but the feeling in the trade is that conditions are improving. The proposed strike among the Western miners may have a tendency to draw Eastern coals into that territory. This will not result in a scarcity of coal, but should, in all probability, enable the mines to bring their output up.

The bids for shipping 360,000 tons of coal for the Panama Canal zone, during the year beginning April 1, show a range of $2.60@2.80, f.o.b. tidewater, for New river coal; $2.65@2.80 for Pocahontas; $2.30@2.80 for Georges creek; $2.50@2.60 for Clearfield; $2.60 for Alabama coal delivered at Pensacola.

In New York harbor good grades of steam coal fetch $2.60@2.65 per ton. Dealers generally report light business and a small demand.

Transportation from mines to tide is good and cars are abundant. In the coastwise trade few vessels are being chartered and many remain tied up.

Birmingham

March 30—Coal operations in Alabama are holding their own. There is a decided improvement over what it was in December. There is a little better movement noticed on the railroads. No new orders have been booked, as far as can be learned, because of the apprehension of a stoppage at the Western mines. The report that several tentative orders have been received and in some instances real business placed, has been verified and railroads have been notified that there is likely to be such a movement. The Illinois Central Railroad will begin operating freight trains into the Birmingham district by April 15.

The coke situation remains unchanged.

Chicago

March 30—The coal market is flat. There is no disposition to buy for storage purposes with labor troubles not ominous, and warm weather coming on. The tendency is toward using fine coals at lower prices, leaving prepared sizes of bituminous to be disposed of at sacrifice prices. Contracts will be largely avoided this year, to judge from present appearances. The average consumer finds the open market convenient and fairly steady. Anthracite is almost stationary. The consumer and retailer alike are awaiting April prices, the 50c. discount for the month being attractive this year. Railroad needs are slowly increasing, but steam plants are consuming little.

Illinois and Indiana sell for $1.70@2.25 lump, $1.65@1.85 for run-of-mine and $1.35@1.55 for screenings. Hocking is at $3.15, smokeless at $3@3.30 for Pocahontas and New River run-of-mine, and Youghiogheny $3.20 for ¾-in. gas. All Eastern coals are weak, as well as Western.

Pittsburg

March 31—The coal market in the Pittsburg district is unsettled, pending an adjustment of the mining rate. A special convention of the United Mine Workers of this district was held here yesterday and is still in session. The large operators also met and both sides appointed committees to arrange details of the new agreement. The conference began this morning and late this afternoon it was announced

that an agreement had not been reached, but that the outlook is favorable for a settlement. It is likely, however, that there will be a suspension, as a number of matters have been introduced by the miners which, if insisted upon, will delay the negotiations. The mines have been running to over 75 per cent. of capacity for several weeks, and considerable coal has been stored. It is reported that the Crucible Steel Company of America has placed an annual contract with the Pittsburg Coal and the Monongahela River Consolidated companies for 300,000 tons of coal. Prices remain unchanged at $1.15 for mine-run coal at the mine. Several small tows of coal went to Southern ports this week, but the aggregate did not reach 1,000,000 bush. There is a large tonnage loaded in the pools and harbor, but it is being held.

Connellsville Coke—Less than half of the ovens in the Connellsville regions are operating. Prices are lower; furnace coke for prompt shipment is $1.60@1.70; on contract, $1.75@1.85. Foundry coke, $2.10 @2.30. One contract for deliveries running to July 1 was closed this week at $2.25. The *Courier*, in its weekly summary, gives the production in both regions at 160,085 tons. The shipments aggregated 6773 cars, distributed as follows: To Pittsburg, 2674; to points west of Connellsville, 3529; to points east of Connellsville, 570 cars.

Foreign Coal Trade

Imports of coal into Spain in January were 15,706 metric tons, an increase of 6528 tons over January, 1906; imports of coke, 5907, an increase of 2076 tons.

Foreign coal trade of Germany in January, in metric tons:

Imports:	1907.	1908.	Changes.
Coal	840,573	543,960	D. 296,613
Brown coal	590,286	696,429	I. 106,143
Total coal	1,430,859	1,240,389	D. 190,470
Coke	19,911	43,351	I. 23,440
Briquets	9,642	15,821	I. 6,179
Exports:			
Coal	1,403,013	1,402,912	D. 101
Brown coal	1,278	1,926	I. 648
Total coal	1,404,291	1,404,838	I. 547
Coke	304,674	309,925	I. 5,251
Briquets	103,427	112,855	I. 9,428

Imports of peat fuel and briquets this year were 1714 tons; exports, 420 tons.

Coal production of Germany in January, metric tons:

	1907.	1908.	Changes.
Coal	12,296,774	12,579,152	I. 282,378
Brown coal	5,131,531	5,702,911	I. 571,380
Total mined	17,428,305	18,282,063	I. 853,758
Coke made	1,768,304	1,858,993	I. 90,689
Briquets made	1,255,746	1,412,431	I. 156,685

Of the briquets reported, 1,090,916 tons were made from brown coal, or lignite.

The coal production of France for the full year was, in metric tons:

	1906.	1907.	Changes.
Coal	33,457,840	36,168,389	I. 2,710,549
Lignite	738,547	761,861	I. 23,314
Total	34,196,387	36,930,250	I. 2,733,863

The production in 1906 was seriously affected by the Courrières disaster.

Iron Trade Review

New York, April 1—There is little change in the condition of the iron market. The call for pig iron is irregular, orders cropping up here and there, but in a way which does not warrant any deductions from them. Prices are also irregular, and it is reported that there is more shading done than either buyers or sellers will confess.

The market for finished material is also an irregular one. Some construction contracts have been let and others are pending, but price seems to be the difficulty. There have been some scattering orders for rails. The Lackawanna Steel Company has taken 24,000 tons for the New York Central, and an order for 6000 tons for Australia has gone to the Pennsylvania Steel Company. The price is said to be $30 per ton, delivered at Sydney, New South Wales. This would mean from $25 to $26 at mill.

Birmingham

March 30—Some buying is going on and consumers are asking for immediate delivery. The Republic company now has two furnaces in operation at Thomas. The Alabama Consolidated will blow in one of the Gadsden furnaces the end of this week.

The Tennessee company has more than 300 men at work in the Bessemer rolling mills. Announcement is made that there will be a shut-down at the steel plant at Ensley this week, in order that some large machinery can be put in. This machinery will double the capacity of the plant. It is understood that from three to six weeks time will be required in putting in the machinery and such labor as desires employment will be taken care of during that time.

Chicago

March 30—Sales of pig iron continue to be small, but there is ground for optimism in the increase of inquiries and the tendency to buy for future delivery. Quotations hold fairly firm. The market runs chiefly to Southern at $13 for most sales, and $12@12.50 mentioned for favorable conditions. Chicago-delivery prices on $13 Birmingham are $16.65 against $18 for Northern iron of No. 2 grade. There is little cutting of Northern prices, the demand being steady and for small lots fairly distributed.

Sales of iron and steel products are light, but slowly increasing. The general situation is much more hopeful.

Coke is dull at $5 for first-class Connellsville with the market well supplied.

Philadelphia

April 1—It is intimated today that furnace capacity is to be cut down in this territory unless some decided change in the situation develops in April. Foundry consumption continues light, though here and there a concern has started on full time. Forge is very dull. There is nothing encouraging in the facts, but people are full of anticipations of a general trade improvement.

Steel Billets—There has been no change in prices and no improvement in demand or inquiry.

Bars—The combination price prevails and as capacity is still largely unemployed there is no possibility of better prices. Store demand continues to improve.

Sheets—This branch of the industry has been making better headway in a retail way.

Pipes and Tubes—Extreme dullness prevails and no orders have been sent to mills.

Plates—Orders for small quantities of tank for local requirements have been placed and will be filled within a week.

Structural Material—A decided improvement in the tone of the market has taken place. There is more business within figuring range this week than there has been for months.

Old Material—Everything is practically dead except railroad scrap. This is being bought up by dealers and consumers on a venture. Other kinds of scrap are selling occasionally.

Pittsburg

March 31—There is evidence of an improvement in the steel market and pig iron is active for a dull period. All the new steel business booked, however, is for small tonnages, but the aggregate is sufficient to keep the mills in the Pittsburg and surrounding territory in operation. A better feeling has developed and steel men take a more optimistic view of the situation. It is possible that the improved demand will be temporary, but present indications seem to point to a steady improvement. Trade is better in sheets. The American Sheet and Tin Plate Company is running to over 50 per cent. of its capacity of sheet mills. No change has been made in the operation of the company's tin-plate mills; about 80 per cent. are going. The wire mills continue to be operated to over 60 per cent. of capacity. The Carnegie Steel Company is operating its plants to about 50 per cent. and the three rail-mills at the Edgar Thomson works are still running. While the railroads continue to delay placing contracts for rails, the Carnegie company is getting some foreign orders.

Pig Iron—Conditions show an improvement over last week. More inquiries have been received for different grades of iron. Some fairly large transactions in Southern iron were closed today in this market. One was for 2000 tons of gray forge for delivery in western New

York at $10.50, Birmingham. Another was for 600 tons of No. 2 foundry at around $12, Birmingham, and 100 tons of No. 2 for Pittsburg delivery at $12.25, Birmingham. Sales of Northern iron were confined to small lots at low prices. Standard bessemer for prompt delivery sold at $17.50, Pittsburg, or $16.60, Valley, the lowest price reached. It is reported that a Valley-furnace interest sold 800 tons of bessemer iron of a special analysis at about $2 a ton above that price. A number of sales of No. 2 foundry in small lots are recorded at $15.50, Valley. Two carloads were sold for delivery in April and May at $15.75. Some additional sales of malleable bessemer for delivery in New England have been made at $16, Valley. Basic iron is not in demand and is quoted around $15.50. Gray forge is weak at $14.50, Valley.

Steel—The crude-steel market is quiet. The price of billets remains at $28, Pittsburg, but mills have agreed to absorb one-half of the freight rate when it is $1 a ton or up to $3 a ton. Sheet-bars and tin-plate bars remain at $29.50 delivered. Plates are 1.70c.; merchant-steel bars, 1.60c.

Sheets—There is a slight improvement. Black sheets are 2.50c.; galvanized, 3.55c. for No. 28 gage.

Ferro-manganese — The market is stronger at not less than $45, Pittsburg. A carload was sold today at $45.50 per ton.

Metal Market

NEW YORK, April 1.

Gold and Silver Exports and Imports

At all U. S. ports, February and year.

Metal.	Exports.	Imports.	Excess.
Gold:			
Feb. 1908..	$ 1,967,597	$ 2,802,431	Imp. $ 834,834
" 1907..	1,127,059	3,329,867	" 2,202,808
Year 1908..	2,411,797	13,734,964	" 11,323,167
" 1907..	3,577,031	6,600,372	" 3,023,341
Silver:			
Feb. 1908..	4,108,774	3,409,777	Exp. $698,997
" 1907..	4,843,970	3,721,988	" 1,121,982
Year 1908..	8,256,918	7,031,651	" 1,225,267
" 1907..	9,610,935	7,379,029	" 2,231,906

Exports from the port of New York, week ended March 28: Gold, $4000 to Haiti; silver, $798,845, chiefly to London. Imports: Gold, $332,427, chiefly from Central America; silver, $17,540, from Mexico and the West Indies.

Imports and exports of gold in the Commonwealth of Australia for the full year are reported as follows:

	1906.	1907.	Changes.
Exports.....	£16,871,265	£10,897,027	D. £5,974,258
Imports.....	2,147,853	1,464,756	D. 683,097
Excess, exp.:	£14,723,432	£ 9,432,271	D. £5,291,161

Nearly all the gold imported comes from New Zealand, simply to be coined or transhipped. The exports of gold are necessarily influenced by the rates offered for shipment, as well as by ordinary exchange operations. The banks now hold in Australia and New Zealand gold to the value of about £30,000,000, an amount in excess of a necessary specie reserve.

Specie holdings of the leading banks of the world March 28 are reported as below, in dollars:

	Gold.	Silver.	Total.
Ass'd New York	.....	.....	$275,210,100
England.....	$203,816,940	.....	203,816,940
France.....	552,900,805	$181,577,110	734,477,915
Germany.....	172,110,000	71,325,000	243,435,000
Spain.....	77,525,000	130,630,000	208,155,000
Netherlands....	38,472,000	22,353,000	60,825,000
Belgium.....	20,723,335	10,361,665	30,085,000
Italy.....	182,085,000	22,500,000	204,585,000
Russia.....	578,420,000	33,520,000	611,940,000
Aust.-Hungary.	232,985,000	63,895,000	296,880,000
Sweden.....	19,505,000	.....	19,505,000
Norway.....	7,440,000	.....	7,440,000
Switzerland....	16,880,000	.....	16,880,000

The New York banks do not separate gold and silver. The foreign statements are from the *Commercial and Financial Chronicle* of New York.

Silver Market

SILVER AND STERLING EXCHANGE.

Mar.	Sterling Exchange.	Silver. New York, Cents.	Silver. London, Pence.	Mar.-Apr.	Sterling Exchange.	Silver. New York, Cents.	Silver. London, Pence.
26	4.8595	55 1/4	25 9/16	30	4.8640	55 3/8	25 9/16
27.	4.8600	55 1/4	25 9/16	31	4.8625	55 3/8	25 9/16
28	4.8625	55 1/8	25 1/2	1	4.8640	55 1/4	25 1/2

New York quotations are for fine silver, per ounce Troy. London prices are for sterling silver, 0.925 fine.

Messrs. Pixley & Abell report silver shipments from London to the East for the year to March 19:

	1907.	1908.	Changes.
India.....	£3,601,910	£1.610,238	D. £1,991,672
China.....	.....	501,400	I. 501,400
Straits.....	85,050	78,270	D. 6,780
Total.....	£3,686,960	£2,189,908	D. £1,497,052

Receipts for the week were £117,000 from New York. Exports were £4600 coin to Australia; £5000 to China, and £184,000 to India; £193,600 in all.

The only recent purchase of silver by the Treasury Department was made last week, and was 100,000 oz. at 55.723c. per oz., delivered.

Indian exchange has been slightly easier, owing to a light demand for money. Only five *lakhs* of Council bills were taken in London, but the price was unchanged, at 15.91d. per rupee.

Other Metals

Mar.-Apr.	Copper. Lake, Cts. per lb.	Copper. Electrolytic, Cts. per lb.	Copper. London, £ per ton.	Tin. Cts. per lb.	Lead. Cts. per lb.	Spelter. New York, Cts. per lb.	Spelter. St. Louis, Cts. per lb.
26	13 1/4 @13 1/2	13 @13 1/4	60 1/4	31 1/2	3.90 @4.00	4.65 @4.70	4.50 @4.55
27	13 1/4 @13 1/2	13 @13 1/4	61 1/4	31 1/2	3.90 @4.00	4.65 @4.70	4.50 @4.55
28	13 1/8 @13 3/8	13 @13 1/4	.....	31 3/4	3.90 @4.00	4.65 @4.70	4.50 @4.55
30	13 1/8 @13 1/4	13 @13 1/4	60 1/4	32	3.90 @4.00	4.65 @4.70	4.50 @4.55
31	13 @13 1/4	12 7/8 @13 1/8	59 7/8	32	3.90 @4.00	4.65 @4.70	4.50 @4.55
1	13 @13 1/4	12 7/8 @13 1/8	58 7/8	31 1/4	3.90 @4.00	4.65 @4.70	4.50 @4.55

London quotations are per long ton (2240 lb.) standard copper, which is now the equivalent of the former g.m.b's. The New York quotations for electroytic copper are for cakes, ingots or wirebars, and represent the bulk of the transactions made with consumers, basis, New York, cash. The price of cathodes is 0.125c. below that of electrolytic. The quotations for lead represent wholesale transactions in the open market. The quotations on spelter are for ordinary Western brands; special brands command a premium.

New York Metal Exchange—At the annual meeting, March 30, an opposition ticket put in nomination was defeated by a large majority, and the following officers were chosen: President, P. R. Jennings; vice-president, Morton B. Smith; treasurer, Robert L. Crooke; managers, B. Hochschild, H. W. Hendricks, L. Vogelstein, G. E. Behr, Paul Koning, George W. Jaques, Emil Baerwald, A. B. Hull; arbitration committee, J. Langeloth, E. A. Caswell, Edwin Groves, E. J. Keane, Humphrey D. Bond.

Copper—Business began to show a falling off toward Saturday last, although prices continued strong and there was still considerable activity. On Monday, however, in consequence of the decline in standard copper at London, apparently influenced by the anxiety to realize on the part of Chinese holders of copper, the market here relapsed into dulness. Producers, having taken considerable business for the coming month, have not pressed sales, but some have made offerings and transactions at lower prices and some rather large quantities of copper in second hands have been offered at lower prices. At the close Lake copper is quoted at 13@13¼c. and electrolytic in cakes, wirebars or ingots at 12⅞@13⅛c.; casting copper has been quoted at an average of 12½@12¾ cents.

The market for standard copper in London advanced on Friday to £61 7s. 6d. for spot and £61 17s. 6d. for three months. On Monday, Tuesday and Wednesday, in consequence of realizations by speculative holders, the market declined steadily, closing at £58 17s. 6d. for spot and £59 7s. 6d. for three months.

For refined and manufactured sorts we quote: English tough, £62 10s.@63 10; best selected, £63@63 10; strong sheets, £74@75.

Tin—Toward the end of last week the activity decreased in the London market, but renewed strength set in the beginning of this week which, however, could not be maintained, seemingly on account of the lack of orders from this side and an increase of visible supplies, which amounted to 800 tons. The close is cabled flat at £141 for spot and £139 15s. for three-months tin.

The domestic market has been very quiet and conspicuous for an entire absence of demand for large lots. Spot tin is still scarce and commanding a slight premium. At the close, prices are quoted at about 31¼c. per pound.

Lead—The market remains quiet. Prices are unchanged at 3.90@4c., New York.

The London market for Spanish lead has gone off somewhat, and at the close is quoted at £14 2s. 6d., and for English lead, £14 5s.

Spelter—The market is quiet and we hear of few transactions. Prices are unchanged, the metal being quoted at 4.65@4.70c., New York, and 4.50@4.55c., St. Louis.

The European market is unchanged, good ordinaries being £21 2s. 6d., and specials, £21 7s. 6d. per ton.

Zinc Sheets—The base price is $7 per 100 lb.—less discount of 8 per cent.—f.o.b. cars at Lasalle and Peru.

Antimony—The market continues dull, and no sales of any consequence have been made. Abroad the situation is firmer. Quotations are 8¾@9c. for Cookson's, 8½@8¾c. for Hallett's, and 7¾@8c. for ordinary brands.

Aluminum—The current price for No. 1 ingots, in ton lots, is 33c. per lb. For rods and wire, No. 0000 to 10, base price is 38c. For sheets, No. 13 to 24, B. & S. gage, base price is 40c. Tubes, 1¼ to 3½ in., base 50c. Higher prices are charged for small lots.

Nickel—For large lots, New York, the chief producer quotes 45@50c. per lb. according to size and terms of sale. For small quantities, 50@65c., same delivery.

Quicksilver—New York quotations are $45 per flask for lots of 100 flasks or over, and $46 for smaller orders. San Francisco quotations are $44.50@45.50 for domestic orders; for export nominal, at about $1.50 lower. The London price is £8 5s. per flask, with £8 3s. 9d. quoted from second hands.

Platinum—The market remains unchanged. Quotations are: $27 per troy ounce for hard platinum, $24.50 for ordinary, and $17 for scrap.

Imports and Exports of Metals

Exports and imports of metals in the United States for the two months ended Feb. 29 are reported as follows, in the measures usual in the trade:

	Exports.	Imports.	Balance.
Copper, long tons	59,352	14,312 Exp.	45,040
Copper, 1907	25,417	19,217 Exp.	6,200
Tin, long tons	50	3,212 Imp.	3,162
Tin, 1907	97	6,226 Imp.	6,129
Lead, short tons	17,195	18,266 Exp.	1,071
Lead, 1907	2,673	11,120 Imp.	8,447
Spelter, sh. tons	255	34 Exp.	221
Spelter, 1907	185	192 Imp.	7
Nickel, lb	2,182,566	2,599,997 Imp.	417,431
Nickel, 1907	1,662,283	2,720,105 Imp.	1,057,822
Antimony, lb	.....	1,574,237 Imp.	1,574,237
Antimony, 1907	.....	2,069,109 Imp.	2,069,109
Platinum, lb	.....	427 Imp.	427
Platinum, 1907	.....	1,853 Imp.	1,853
Quicksilver, lb	31,430	..... Exp.	31,430
Quicksilver, '07	132,466	..... Exp.	132,466
Aluminum, value	$10,722	..... Exp.	$10,722
Aluminum, 1907	66,264	..... Exp.	66,264

Copper, lead, spelter and nickel include metal contents of ores, matte, bullion, etc. Zinc ores exported were 4046 tons in 1907, and 6067 tons in 1908; zinc dross 4,765,025 lb. in 1907 and 5,066,965 lb. 1908. Zinc ores imported this year, 3648 tons calamine and 2637 tons other ores, 6285 tons in all; not reported last year. Antimony ores imported, 444,294 lb. in 1907, and 121,603 lb. in 1908. Exports include re-exports of foreign material.

Missouri Ore Market

Joplin, Mo., March 28—The highest price reported paid for zinc was $39.50, on a base price of $36 per ton of 60 per cent. zinc, the base ranging down to $34 per ton on less desirable ores, and the price of all grades averaging $33.36 per ton. Lead sold freely at $52 per ton, with unverified rumors of $53 and $54 being paid for a few choice bins. Medium grades sold from $50 to $51.50, and all grades averaged $50.82 per ton.

The reserve stock of zinc ore has been practically wiped out, certain interests having purchased every ton of ore for sale on a $35 base price the past three weeks, leaving under 2000 tons of unsold ore in the district.

Following are the shipments of zinc and lead ore from the various camps of the district for the week ending March 28:

	Zinc, lb.	Lead, lb.	Value.
Webb City-Carterville	1,795,670	903,240	$53,558
Joplin	2,395,210	248,500	49,451
Badger	1,701,480	118,330	32,802
Galena	722,600	167,040	16,543
Duenweg	696,200	64,500	13,479
Quapaw	682,370	78,600	12,239
Alba-Neck	556,700	.....	10,298
Granby	510,000	47,000	7,300
Aurora	254,270	8,690	4,091
Prosperity	177,080	41,350	4,064
Spurgeon	251,850	12,500	5,549
Carthage	183,600	.....	3,396
Sarcoxie	147,720	.....	2,341
Cave Spring	48,440	.....	847
Zincite	37,820	.....	642
Wentworth	44,600	.....	357
Totals	10,305,610	1,689,750	$214,957
13 weeks	112,275,440	15,999,760	$2,350,594
Zinc value, the week, $171,181; 13 weeks, $1,958,605			
Lead value, the week, 43,076; 13 weeks, 391,989			

Average ore prices in the Joplin market were, by months:

ZINC ORE AT JOPLIN.			LEAD ORE AT JOPLIN.		
Month.	1907.	1908.	Month.	1907.	1908.
January	45.84	35.56	January	83.58	46.88
February	47.11	34.92	February	84.58	49.72
March	48.66	34.19	March	82.75	49.90
April	48.24	.....	April	79.76	.....
May	45.98	.....	May	79.56	.....
June	44.82	.....	June	73.66	.....
July	45.79	.....	July	58.18	.....
August	43.22	.....	August	59.54	.....
September	40.11	.....	September	53.52	.....
October	39.83	.....	October	51.40	.....
November	35.19	.....	November	43.40	.....
December	30.87	.....	December	37.71	.....
Year	43.68	.....	Year	68.90	.....

Wisconsin Ore Market

Platteville, Wis., March 28—The highest price paid this week for zinc ore was $37 per ton on a basis of $36 per ton of 60 per cent. zinc. Lead ore sold at $25 per thousand for 80 per cent. lead.

Ore shipments for the week ended March 28 were:

Camps.	Zinc ore, lb.	Lead ore, lb.	Sulphur ore, lb.
Platteville	464,390	.....	.....
Benton	337,070	61,800	.....
Livingston	160,000	.....	.....
Hazel Green	87,200	.....	.....
Harker	65,320	.....	.....
Total	1,113,980	61,800	.....
Year to Mar. 28	16,236,500	1,087,285	79,800

Shipments of zinc ore, totaling 218,600 lb., credited by error to Mineral Point in reports of March 14 and 21, belong properly to Highland and Linden; 66,600 lb. to Highland and the balance to Linden.

Chemicals

New York, April 1—The general market shows a little life in a few lines but, for the most part, is dull. Agricultural chemicals, however, are improving.

Copper Sulphate—The usual spring demand is being felt, but not to as great a degree as is usual at this time. Prices remain unchanged at $5 per 100 lb. for carloads and $5.25 for smaller lots.

Nitrate of Soda—The demand from agricultural sources is greatly improved and considerable business is being done. Powder manufacturers are not in the market to any extent. Prices remain unchanged at 2.40c. for all positions of 1908; 2.37½c. for 1909; and 2.32½c. for 1910. The 96 per cent. grade sells 5c. per 100 lb. higher.

Mining Stocks

New York, April 1—The general stock market has been rather variable, and the close is marked by a reaction which has affected nearly all stocks. In part this is based on various news which may be unfavorably constructed, and in part on the slow recovery of business; but it is still so largely a professional market, that deductions are apt to be unsafe. The market closes rather heavy and depressed.

There was a sale of Homestake, of South Dakota, on the exchange yesterday, 100 shares changing hands at $73.50 per share.

The curb market was demoralized by the trading in Yukon Gold, introduced by the Lawson advertisements. On the first day the market was wild and it is difficult to give any reliable quotation; but $7.50 was probably the highest. At the close this stock was heavy at $5@5.50. Other mining stocks were neglected.

Boston

March 31—After a few days of farther advancing prices, mining shares have lost their buoyancy, and, with but few exceptions, prices show a net decline from those of a week ago. Fluctuations in stocks for the week have been wide in cases. Calu-

met & Arizona had a $10 drop from the high to $97, with $3 recovery. The annual report for 1907 was a disappointment. The action of Boston Consolidated has been mystifying. It has dropped $4.12½ per share to $11.62½, with but feeble recovery from this. The selling has been persistent. There was a report of the liquidation of a block of stock for foreign account. Even the offer of President Samuel Newhouse to take the stock at $15 up to the value of $2,000,000 did not stay the market.

The United States Coal and Oil Company has prepared a plan to finance the company.

Yukon Gold has been the curb feature, but closed at its lowest tonight, $5.

STOCK QUOTATIONS

NEW YORK Mar. 31	Clg.
Alaska Mine	¾
Am.Nev.M.&P.Co.	....
Amalgamated	58⅞
Anaconda	37½
Balaklala	2
British Col. Cop.	4¾
Buffalo Cobalt	....
Butte & London	....
Butte Coalition	21½
Butte Cop. & Zinc.	....
Cobalt Contact	....
Colonial Silver	⅝
Cum. Ely Mining.	8⅜
Davis Daly	3⅝
Dominion Cop.	2⅛
Douglas Copper	4⅝
El Rayo	1⅝
Foster Cobalt	.59
Furnace Creek	.19
Giroux Mine	4
Gold Hill	1/16
Granby, New	....
Greene Gold	⅜
Greene G. & S	½
Greenw'r & D.Val.	.75
Guanajuato	2¼
Guggen. Exp.	155
Hanapah	....
McKinley Dar.	.70
Micmac	4⅛
Mines Co. of Am.	1⅛
Mitchell Mining	.75
Mont.Sho. C.(New)	2⅞
Nev. Utah M. & S	4
Newhouse M. & S.	7
Nipissing Mines	6⅝
Old Hundred	¾
Silver Queen	1
Stewart	¾
Tennessee Cop'r.	41½
Union Copper New	1⅛
Utah Apex	4¼
Utah Copper	32⅛
West Columbus	....

N. Y. INDUSTRIAL	
Am. Agri. Chem.	17½
Am. Smelt. & Ref.	67⅛
Am. Sm. & Ref., pf.	94¾
Bethlehem Steel	....
Colo. Fuel & Iron.	23⅝
Federal M. & S.,pf.	69
Inter. Salt	10½
National Lead	55⅞
National Lead, pf.	....
Pittsburg Coal	....
Republic I. & S.	18
Republic I. & S.,pf.	71½
Sloss-Sheffield	46½
Standard Oil	530
Tenn. C. & I.	....
U. S. Red. & Ref.	....
U. S. Steel	33⅜
U. S. Steel, pf	98
Va. Car. Chem	....
Va. I. Coal & Coke	....

ST. LOUIS Mar. 28	High.	Low.
Adams	.40	.25
Am. Nettie	.04	.03
Center Cr'k	2.00	1.50
Cent. C. & C.	66.00	64.00
C.C. & C. pd.	76.00	75.00
Cent. Oil	100.00	90.00
Columbia	4.00	3.00
Con. Coal	19.00	15.00
Doe Run	125.00	110.00
Gra. Bimet.	.25	.20
St. Joe.	15.00	12.00

BOSTON Mar. 31	Clg.
Adventure	....
Allouez	25
Am. Zinc	23½
Arcadian	3⅞
Atlantic	9
Bingham	1¼
Boston Con	12
Calumet & Ariz.	100
Calumet & Hecla*	635
Centennial	....
Con. Mercur	.33
Copper Range*	65
Daly West	9
Franklin	7¼
Greene-Can	8⅜
Isle Royal	18
La Salle	14
Mass	2¾
Michigan	11
Mohawk	50
Mont.C.&C. (new)	....
Nevada	11⅝
North Butte	53⅞
Old Colony	....
Old Dominion	36¼
Osceola	....
Parrot	18¼
Phoenix	....
Quincy	82
Rhode Island	3
Santa Fe	1¾
Shannon	11⅞
Superior	....
Tamarack	....
Trinity	14¼
United Cop., com.	....
U. S. Oil	9⅜
U. S. Smg. & Ref*.	36
U.S.Sm. & Re.,pd*.	39¾
Utah Con*	38½
Victoria	3
Washington	....
Winona	5¼
Wolverine	....
Wyandotte	....

*Ex. Div. †Ex. Rights.

BOSTON CURB	
Ahmeek	....
Ariz. Com	....
Black Mt	4
East Butte	....
Hancock Con	....
Keweenaw	5¼
Majestic	.90
Raven	1⅜
Shawmut	.35
Superior & Pitts.	12¾
Troy Man	.65

LONDON Apr. 1	Clg.
Name of Com.	£1 5s 0d
Dolores	0 3 3
Stratton'sInd.	0 14 0
Camp Bird	1 6 3
Esperanza	1 8 9
Tomboy	1 2 6
El Oro	0 11 6
Oroville	. . .
Somera	. . .
Utah Apex	. . .
Ariz. Cop.,pfd.	. . .
Ariz. Cop.,def.	

Cabled through Wm. P. Bonbright & Co., N.Y.

NEVADA STOCKS. April 1.
Furnished by Weir Bros. & Co., New York.

Name of Comp.	Clg.	Name of Comp.	Clg.
COMSTOCK STOCKS		Silver Pick	.23
Belcher	.10	St. Ives	.28
Best & Belcher	.56	Triangle	.08
Caledonia	...	BULLFROG STOCKS	
Challar	.07	Bullfrog Mining	.06
Con. Cal. & Va	.40	Bullfrog Nat. B.	.09
Crown Point	.22	Gibraltar	.08
Exchequer	...	Gold Bar	.17
Gould & Curry	...	Homestake King.	.33
Hale & Norcross	.29	Montgomery Mt.	.14
Mexican	.85	Mont. Shoshone C.	2.62½
Ophir	2.35	Original Bullfrog.	.02
Overman	.02	Tramp Cons	.21
Potosi	.04	MANHAT'N STOCKS	
Savage	.32	Manhattan Cons.	.17
Sierra Nevada	.32	Manhat'n Dexter.	.07
Union	.35	Jumping Jack	.04
Utah	...	Stray Dog	.07
Yellow Jacket	.71	MISCELLANEOUS	
TONOPAH STOCKS		Golden Boulder	...
Belmont	1.06½	Hayseed	...
Extension	.81½	Lee Gold Grotto	.03
Golden Anchor	.02	Nevada Hills	2.75
Jim Butler	.30	Nevada Smelting.	1.25
MacNamara	.36	Pittsburgh S. Pk.	1.06½
Midway	.56	Round Mt. Sphinx	.28
Montana	1.67		
North Star	.13		
Tono'h Mine of N.	7.37½		
West End Con	.25		
GOLDFI'D STOCKS			
Adams	.06		
Atlanta	.25		
Booth	.21		
Columbia Mt.	.22		
Comb. Frac	.69		
Cracker Jack	.09		
Dia'dfield B. B. C.	.16		
Goldfield Belmont	.16		
Goldfield Con	5.12½		
Goldfield Daisy	1.28		
Great Bend	.41		
Jumbo Extension	.32		
Katherine	.05		
Kendall	.20		
Lone Star	.09		
May Queen	.08		
Oro	.08		
Red Hill	.26		
Roanoke	.02		
Sandstorm	.36		

COLO. SPRINGS Mar. 28

Name of Comp.	Clg.
Acacia	7
Black Bell	....
C. C. Con	3¾
Dante	7¼
Doctor Jack Pot	6¾
Elkton	52
El Paso	33
Findlay	30
Gold Dollar	....
Gold Sovereign	3½
Isabella	35¼
Index	....
Jennie Sample	3¼
Jerry Johnson	....
Mary McKinney	30
Pharmacist	....
Portland	1.03
Un. Gold Mines	....
Vindicator	80¼
Work	13

New Dividends

Company.	Payable.	Rate.	Amt.
Am. Ag. Chem., pfd	Apr. 15	$3.00	$544,590
Arizona, pref., A	Apr. 1	1.20	75,962
Calumet & Arizona	Apr. 25	1.00	200,000
Central C. & C., com	Apr. 15	1.50	76,875
Central C. & C., pfd	Apr. 15	1.25	23,438
Copper Range Con	Apr. 1	1.00	383,781
Dominion Coal, com	Apr. 1	1.00	150,000
Florence (Goldfield)	Apr. 1	0.10	125,000
Gen. Chem ical,pfd	Apr. 2	1.50	150,000
Guggenheim Exp.	Apr. 7	2.50	262,500
Inter. Nickel, pfd	May 1	1.50	131,123
Mammoth	Mar. 25	0.05	20,000
New Idria	Apr. 1	0.30	30,000
Nipissing	Apr. 20	0.15	180,000
N. S. St. & Coal, com	Apr. 15	1.50	74,814
N. S. St. & Coal, pfd	Apr. 15	2.00	20,600
Penn. Salt Mfg.	Apr. 15	3.00	180,000
Republic I. & S., pfd	Apr. 1	1.75	357,296
Sloss. Sheff., pfd	Apr. 1	1.75	117,250
United Metals Selling	Apr.	5.00	250,000
Utah Con	Apr. 15	0.50	150,000
Va. Car. Chem., pfd	Apr. 15	2.00	360,000
Westmoreland Coal	Apr. 1	5.00	150,000
Wolverine	Apr. 1	5.00	300,000
Work	Apr. 4	0.01	15,000

Assessments

Company.	Delinq.	Sale.	Amt.
Blackjack Con., Utah	Feb. 20	Mar. 16	$0.03
Blue Bell, Utah	Feb. 15	Apr. 15	0.01
Butte & Yerrington, Nev.	Mar. 25	Apr. 16	0.02
Caledonia, Nev.	Mar. 10	Apr. 1	0.10
Century, Utah	Apr. 14	May 14	0.02
Champion, Cal.	Apr. 2	Apr. 22	0.50
Con. Imperial, Nev.	Mar. 11	Apr. 2	0.01
Duleek, Cal.	Mar. 6	Mar. 23	0.05
Eastern & Western, Utah	Mar. 16	Apr. 6	0.01
Exchequer, Nev.	Feb. 27	Mar. 19	0.05
Hannapah, Utah	Feb. 6	Mar. 10	0.01
Jenny Lind, Cal.	Mar. 10	Mar. 26	0.02
Julia, Nev.	Feb. 24	Mar. 18	0.03
Quincy, Jr., Utah	Mar. 21	Apr. 20	0.02
Scottish Chief, Utah	Mar. 18	Apr. 10	0.01
Skylark, Utah	Mar. 27	Apr. 14	0.01
Sierra Queen, Cal.	Mar. 15	Apr. 3	0.02
Trumbull Oil, Cal.	Feb. 24	Mar. 24	0.01
Union Con., Nev.	Mar. 2	Mar. 26	0.10
Western Mines, Nev.	Mar. 16	Apr. 23	0.01½

Monthly Average Prices of Metals

AVERAGE PRICE OF SILVER

Month.	New York. 1907.	New York. 1908.	London. 1907.	London. 1908.
January	68.673	55.678	31.769	25.738
February	68.835	56.000	31.852	25.855
March	67.519	55.365	31.325	25.570
April	65.462	.....	30.253	.....
May	65.981	.....	30.471	.....
June	67.090	.....	30.893	.....
July	68.144	.....	31.366	.....
August	68.745	.....	31.637	.....
September	67.792	.....	31.313	.....
October	62.435	.....	28.863	.....
November	58.677	.....	27.154	.....
December	54.565	.....	25.362	.....
Year	65.327	.....	30.188	.....

New York, cents per fine ounce; London, pence per standard ounce.

AVERAGE PRICES OF COPPER

	NEW YORK. Electrolytic 1907.	Electrolytic 1908.	Lake. 1907.	Lake. 1908.	LONDON. 1907.	LONDON. 1908.
January	24.404	13.726	24.825	13.901	106.739	62.386
February	24.869	12.905	25.236	13.098	107.356	58.786
March	25.065	12.704	25.560	12.875	106.594	58.761
April	24.224	.....	25.260	.....	98.625	.....
May	24.048	.....	25.072	.....	102.375	.....
June	22.665	.....	24.140	.....	97.272	.....
July	21.130	.....	21.923	.....	95.016	.....
August	18.356	.....	19.255	.....	79.679	.....
September	15.565	.....	16.047	.....	68.375	.....
October	13.169	.....	13.551	.....	60.717	.....
November	13.391	.....	13.870	.....	61.226	.....
December	13.163	.....	13.393	.....	60.113	.....
Year	20.004	.....	20.661	.....	87.007	.....

New York, cents per pound. Electrolytic is for cakes, ingots or wirebars. London, pounds sterling, per long ton, standard copper.

AVERAGE PRICE OF TIN AT NEW YORK

Month.	1907.	1908.	Month.	1907.	1908.
January	41.548	27.380	July	41.091	.....
February	42.102	28.978	August	37.667	.....
March	41.313	30.577	September	36.689	.....
April	40.938	.....	October	32.620	.....
May	43.149	.....	November	30.833	.....
June	42.120	.....	December	27.926	.....
			Av. year	38.166	.....

Prices are in cents per pound.

AVERAGE PRICE OF LEAD

Month.	New York. 1907.	New York. 1908.	London. 1907.	London. 1908.
January	6.000	3.691	19.828	14.469
February	6.000	3.725	19.531	14.250
March	6.000	3.838	19.703	13.975
April	6.000	.....	19.975	.....
May	6.000	.....	19.688	.....
June	5.760	.....	20.188	.....
July	5.288	.....	20.350	.....
August	5.250	.....	19.063	.....
September	4.813	.....	19.775	.....
October	4.750	.....	18.531	.....
November	4.376	.....	17.281	.....
December	3.658	.....	14.500	.....
Year	5.325	.....	19.034	.....

New York, cents per pound. London, pounds sterling per long ton.

AVERAGE PRICE OF SPELTER

MONTH.	New York. 1907.	New York. 1908.	St. Louis. 1907.	St. Louis. 1908.	London. 1907.	London. 1908.
January	6.732	4.513	6.582	4.363	27.125	20.563
February	6.814	4.788	6.664	4.638	25.938	20.875
March	6.837	4.665	6.687	4.527	26.094	21.075
April	6.685	.....	6.535	.....	25.900	.....
May	6.441	.....	6.291	.....	25.563	.....
June	6.419	.....	6.269	.....	25.469	.....
July	6.072	.....	5.922	.....	23.850	.....
August	5.701	.....	5.551	.....	21.969	.....
September	5.236	.....	5.086	.....	21.050	.....
October	5.430	.....	5.280	.....	21.781	.....
November	4.925	.....	4.775	.....	21.438	.....
December	4.254	.....	4.104	.....	20.075	.....
Year	5.962	.....	5.812	.....	23.771	.....

New York and St. Louis, cents per pound. London in pounds sterling per long ton.

Metal and Mining Companies—U. S.

Name of Company and Location.		Author-ized Capital	Shares. Issued.	Par Val.	Dividends. Total to Date.	Latest. Date.	Amt.
Alaska Mexican, g.	Al'ka	$1,000,000	180,000	$ 5	$1,806,381	Jan. 1908	$ .50
Alaska Treadwell, g.	Al'ka	5,000,000	200,000	25	9,785,000	Jan. 1908	.75
Alaska United, g.	Al'ka	1,000,000	180,200	5	333,370	Jan. 1908	.50
Amalgamated, c.	Mont	155,000,000	1,530,879	100	55.942,865	Feb. 1908	.50
Am.Sm.&Ref.,com.	U. S.	50,000,000	500,000	100	13,125,000	Apr. 1908	1.00
Am. Sm. & Ref. pf.	U. S.	50,000,000	500,000	100	27,088,053	Apr. 1908	1.75
Am. Smelters, pf. A	U. S.	17,000,000	170,000	100	2,450.000	Mar. 1908	1 50
Am. Smelters. pf. B	U. S.	30,000,000	300.000	100	4,125,000	Mar. 1908	1.25
Am.Zinc,Lead&Sm.	Kan.	3,750,000	80,000	25	100.000	Nov. 1907	.50
Anaconda,c.	Mont	30,000,000	1,200,000	25	39,050,000	Jan. 1908	.50
Arizona, c	Ariz	3,775,000	3,682,520	.....	6,182,361	Apr. 1906	.05
Atlantic, c	Mich	2,500,000	100,000	25	990.000	Feb. 1905	.02
Bald Butte, g. s.	Mont	250,000	250,000	1	1,354,648	Oct. 1907	.04
Beck Tunnel, g.s.l.	Utah	100,000	1,000,000	0.10	615,000	Oct. 1907	.02
Bingham & N.H.,c.g	Utah	2,000,000	226,000	5	22,600	Sept. 1906	.10
Boston & Montana.	Mont	3,750,000	150,000	25	49 225 000	Feb. 1908	3.00
Bull.Beck.&Cham.g	Utah	1,000,000	100,000	10	2,688,400	Apr. 1907	.10
Bunker Hill & Sull.	Ida	3,000,000	300.000	10	9,996,000	Mar. 1908	.20
Butte Coalition,c.s.	Mont	15,000,000	1,000,000	15	2.450 000	Dec. 1907	.15
Calumet & Arizonac	Ariz	2,500,000	200,000	10	9.5 0 000	Apr. 1908	1 00
Calumet & Hecla,c.	Mich	2,500,000	100,000	25	106.350.000	Mar. 1908	5.00
Camp Bird, g., s.	Colo	5,500,000	820,000	5	5,229,673	Mar. 1908	.48
Cariaa, c.g.	Utah	500,000	500,000	1	55,000	Nov. 1906	.01
Colorado, l. g. s.	Utah	200,000	1,000,000	0.20	670,000	Jan. 1908	.05
Columbus Con. c.	Utah	1,500,000	283,540	5	226,832	Oct. 1907	.20
Combi'tion Co.G'f'd	Nevada	400,000	320,000	1	688,000	Sept. 1906	.15
Con. Mercur, g.	Utah	1,000.000	1,000,000	1	1,205.000	Dec. 1906	.02½
Continental, z. l.	Mo.	550,000	22,000	25	220,000	Oct. 1907	.50
Copper Range Con.	Mich	38,500,000	383.781	100	6,861,582	Apr. 1908	1.00
Creede United, g.	Colo.	2,000.000	1,625,000	1	214 053	July 1906	.00½
Daly Judge, g. s. l.	Utah	300 000	300,000	1	225,000	Apr. 1907	.37½
Daly West, g. s. l.	Utah	3,600,000	180,000	20	5,877,000	Dec. 1907	.30
De Lamar, g. s	Ida	400,000	67,180	5	2,926,370	May 1905	.72
Dillon, g.	Colo.	1,250,000	1,250,000	1	21,875	July 1905	.01
Doctor Jack Pot	Colo.	3,000,000	3,000,000	1	268,000	July 1906	.00½
Doe Run, l.	Mo.	10,000,000	59,062	100	1,523,631	Mar. 1908	.50
Elkton Con., g.	Colo.	3,000,000	2,500,000	1	2,041,960	Feb. 1908	.01½
El Paso, g.	Colo.	2,500,000	2,450,000	1	1.022.750	June 1906	.01
Fed. Sm., com.	Idaho	10,000,000	60.000	100	2,708,750	Mar. 1908	1.50
Federal Sm., pf.	Idaho	20,000,000	120,000	100	3,491,250	Mar. 1908	1.75
Findley, g.	Colo.	1,250,000	1.250.000	1	325.000	Aug. 1906	.01
Florence, g.	Nevada	1,250,000	1,050,000	1	210,000	Apr. 1908	.10
Frances-Mohawk,g	Nevada	1,000,000	910,000	1	410,000	Jan. 1908	.05
Gemini-Keystone	Utah	500,000	5,000	100	1,950 000	July 1907	10.00
Gold King Con	Colo.	5.750.370	5,750.370	1	1.407 504	May 1905	.01
Goldfield Con., g.	Nevada	50,000,000	5,000,000	10	1,000,000	Nov. 1907	.10
Grand Central, g.	Utah	25,,000	250,000	1	1,333,000	Oct. 1907	.05
Gwin Mine, Dev., g.	Cal	1,000,000	100,000	10	496,000	Apr. 1906	.05
Hecla, s. l.	Idaho	250 000	1,000,000	0.25	1,450,000	Feb. 1908	.01
Homestake, g.	S. D.	22,000,000	218 400	100	22,531,640	Mar. 1908	.50
HornSilver,g.s.c.z.l	Utah	10,000 000	400,000	25	5,642,000	Sept. 1907	.05
Inter'l Nickel, pf.	N. Y.	12,000,000	87,415	100	1,180,115	May 1908	1.50
Iron Silver	Colo.	10,000,000	500,000	20	4,100,000	Oct. 1907	.10
Jamison, g.	Cal	3,900 000	390,000	10	294,070	Jan. 1908	.02
Jerry Johnson.	Cal	2,500,000	2,500,000	1	86,700	Jan. 1908	.01
Kendall, g.	Mont	2,500,000	500 000	5	1,205,000	Feb. 1908	.02
Liberty Bell,g. s.	Colo.	700,000	130,551	5	130,440	Jan. 1907	.15
Lightner, g.	Cal	125,000	102,255	1	295.694	Aug. 1905	.05
Lower Mammoth, g	Utah	190,000	190,000	1	42,750	Aug. 1907	.07½
Mammoth, g. s. l.	Utah	10,000 000	400,000	2.50	2,220,000	Mar. 1908	.05
Mary McKinney, g.	Colo.	1,500,000	1,304,252	1	801.765	Apr. 1907	.03
May Day, g. s. l.	Utah	800,000	800,000	1	70,010	Oct. 1907	.01½
Mohawk, c.	Mich	2,500,000	100,000	25	1,400,000	July 1907	5.00
Mont. Ore Purch.	Mont	2,500,000	80,833	25	9 437.274	Jan. 1907	15.00
Nevada Hills, s.g.	Nevada	1,000,000	750,000	1	375,000	Dec. 1907	.10
New Century, z., l.	Mo.	300,000	300,000	1	230,300	Aug. 1907	.00½
Newhouse M. & S.c.	Utah	6,000,000	600,000	10	300,000	Sept. 1907	.50
New Idria, q	Cal	500.000	100,000	5	930,000	Apr. 1908	.30
New Jersey Zinc	U. S.	10,000,000	100,000	100	8.400,000	Feb. 1906	3.00
North Butte	Mont	6,000,000	400,000	15	5,800,000	Sept. 1907	2.00
North Star, g.	Cal	2.500.000	250.000	10	1,599 489	Mar. 1908	.25
Old Dominion, c.	Ariz	8,750,000	293,245	25	574,088	Aug. 1907	1.00
OldDominion,M&Sc	Ariz	5,000,000	162,000	25	202,500	Aug. 1907	1.25
Old Gold	Colo.	2,101,150	2,101,150	1	10,506	Mar. 1906	.05
Ophir, g. s	Nevada	302,400	100,800	3	1,797,400	July 1904	.25
Osceola, c	Mich	2,500,000	96,150	25	7.035 650	July 1907	7.00
Parrot, c,s	Mont	2,300,000	229,850	10	6,807.649	Sept. 1907	.25
Pennsylvania, g.	Cal	5.150.000	51,500	100	284,925	July 1905	.10
Pitts. L. & Z., l.z.	Mo	1,000,000	1,000,000	1	20.000	July 1907	.02
Portland, g.	Colo.	3,000,000	3,000.000	1	7,747.080	Jan. 1908	.04
Quartette, g. s.	Nevada	1,000,000	100 000	10	375,000	July 1907	.20
Quincy, c	Mich	3,750,000	110,000	25	18,110,446	Mar. 1908	1.50
Rocco Homest'k,l.s.	Nevada	300,000	300,000	1	112 000	Dec. 1905	.02
Sacramento, g, q.	Utah	1.000.000	1,000,000	1	258,000	Nov. 1906	.00½
St. Joseph, l.	Mo.	20,000,000	1,000 000	10	5,708,357	Mar. 1908	.15
Silver Hill, g. s	Nevada	108,000	108 000	1	81 000	June 1907	.05
Silver King, g. s. l †	Utah	3.000.000	150,000	20	11,187,500	July 1907	.33½
Silver King Co't'n †	Utah	6,250,000	1,250,000	5	187,500	Oct. 1907	.15
Shannon, c	Ariz	3,000,000	300,000	10	450 000	July 1907	.50
Snowstorm, s. l.	Ida	1,500,000	1,500,000	1	450,000	Sept. 1907	.03
Standard Con., g. s.	Cal	2,000,000	178,600	10	5,192,641	Dec. 1907	.10
Stratton'sIndepend	Colo.	5,500,000	1,000.007	5	4 895.865	Apr 1906	.12½
Swansea, g. s. l	Utah	500,000	100,000	5	329,500	Mar. 1907	.05
Tamarack, c	Mich	1,500,000	60,000	25	9,420,000	July 1907	4.00
Tennessee, c	Tenn	5,000,000	200,000	25	1,806,250	Feb. 1908	1.25
Tomboy, g. s	Colo.	1,750,000	300,000	5	900 000	June 1906	.48
Tonopah of Nev.	Nevada	1,000,000	1,000,000	1	3,500,000	Oct. 1907	.25
Tonopah Belmont.	Nevada	2,000,000	1,295,007	1	518,003	Apr. 1907	.10
Tonopah Ext'nsion	Nevada	1,000,000	928,433	1	278,530	Apr. 1906	.15
Tonopah Midway	Nevada	1,000,000	1,000,000	1	300,000	Jan. 1907	.05
Uncle Sam, g.s.l.	Utah	500.000	500.000	1	165 000	Oct. 1907	.03
United States, com.	Utah	37,500,000	350,933	50	1,096,232	Jan. 1908	.50
United States, pfd.*	Utah	37,500,000	485,845	50	3,180,929	Jan. 1908	.87½
United Cop. com.	Mont	75,000,000	450,000	100	5,962,500	Aug. 1907	1.75
United, c. pf	Mont	5 000,000	50.000	100	1.500.000	May 1907	3.00
United, z. l., pf	Mo.-Kan.	500,000	19.556	25	303,006	Oct. 1907	.50
United Verde, c.	Ariz.	3,000,000	300,000	10	19 935 322	Mar. 1908	.75
U.S. Red. & Ref. Pf	Colo.	4,000,000	39,458	100	1,005.504	Oct. 1907	1.50
Utah, g.(Fish Sp'gs)	Utah	1,000.000	100,000	10	291,000	Jan. 1908	.03
Utah Con., c.	Utah	1,500,000	300,000	5	7,836,000	Apr. 1908	.50
Victoria, Utah	Utah	250,000	250,000	1	177,500	Mar. 1907	.04
Vindicator Con., g.	Colo.	1,500.000	1,500,000	1	1,770.000	Jan. 1908	.04
Wolverine, c.	Mich	1,500,000	60,000	25	4,800,000	Apr. 1908	5.00
Work, g	Colo.	1,500,000	1,500,000	1	165,000	Apr. 1908	.01
YankeeCon	Utah	500,000	500,000	1	157,500	Oct. 1907	.03
Yellow Aster, g.	Cal	1,000,000	100,000	10	958,789	Aug. 1907	.20

*Previous to consolidation $1,436,250 were divided. †Amalgamated.

Coal, Iron and Other Industrials—United States.

Name of Company and Location.		Author. ized Capital.	Shares. Issued.	Par Val. $	Dividends. Total to Date.	Latest. Date.	Amt.
Ala. Con., C. & I., pf.	Ala	$2,500,000	24,638	100	$905,265	May 1905	$1.75
Allis-Chalmers, pf.	U S	25,000,000	200,000	100	3,213,750	Feb. 1904	1 75
Amer. Ag. Chem., pf.	U. S	20,000,000	181,530	100	9,002,752	Apr. 1908	3.00
American Cement	Pa.	2,000,000	200,000	10	1,168,000	Jan. 1908	.30
American Coal	Md	1,500,000	50,000	25	2,367,500	Sept. 1907	1.25
Associated Oil	Cal	21,000,000	21,000,000	1	630,000	Aug. 1905	.01
Bethlehem Steel, pf.	Pa.	15,000,000	150,000	100	900,000	Nov. 1906	.75
Cambria Steel	Pa.	50,000,000	900,000	50	9,337,500	Feb. 1908	.75
Caribou Oil	Cal	100,000	80,000	1	56,000	July 1905	.07
Central C. & C., com.	Mo	5,125,000	51,250	100	2,229,375	Apr. 1908	1.50
Central C. & C., pf.	Mo	1,875,000	18,750	100	1,359,378	Apr. 1908	1.25
Central Oil	W. Va.	1,500,000	60,000	25	182,500	May 1904	.25
Claremont Oil	Cal	500,000	450,000	1	58,500	June 1905	.01
Col. & Hock. C.& I.pf.	Ohio	7,000,000	69,244	100	383,818	Apr. 1908	1 50
Consolidated Coal	Ill.	5,000,000	50,000	100	350,000	July 1904	1.00
Consolidation Coal	Md.	10,250,000	102,500	100	9,621,650	Jan. 1908	3.50
Crucible Steel, pf	Pa.	25,000,000	250,000	100	2,125,000	June 1907	1.50
Empire S. & I., pf.	N. J.	5,000,000	25,000	100	787,500	Jan. 1908	3.00
Fairmont Coal,	W. Va.	12,000,000	120,000	100	2,100,000	Jan. 1908	2.00
Four Oil	Cal	500,000	300,000	1	105 406	July 1905	.01
General Chem. com.	U. S.	12,500,000	74,103	100	2,041,537	Mar. 1908	1.00
General Chem., pf.	U. S.	12,500,000	100,000	100	5,140,178	Apr. 1908	1.50
George's C'k Coal	Md	2,500,000	22,000	100	1,188,000	July 1904	3.00
Imperial Oil	Cal	1,000,000	100,000	100	880,000	July 1905	.20
International Salt.	Penn.	30,000,000	182,280	100	927,060	Dec. 1906	1.00
Jeff. & Cl'f C. & I., cm	Pa.	1,500,000	15,000	100	330,000	Aug. 1905	5.00
Jeff. & Cl'f. C. & I., pf.	Pa.	1,500,000	15,000	100	938,000	Feb. 1908	2.50
Kern River Oil	Cal	2,000,000	20,000	100	39,500	May 1905	.13
Lehigh Coal & Nav.	Pa.	17,378,500	346,901	50	26,308,495	Nov. 1907	2.00
Maryland Coal,pf.	Md.	2,000,000	18,850	100	1,667,960	Jan. 1908	4.00
Monon R. Coal, pf.	Pa.	10,000,000	100,000	100	3,854.945	Jan. 1908	3.50
National Carbon, pf.	U. S.	4,500,000	45,000	100	2,047,500	May 1905	1.75
National Lead, com.	N. Y.	15,000,000	149,054	100	2,533,919	Apr. 1908	1.25
National Lead, pf.	N. Y.	15,000,000	149,040	100	17,111,788	Mar. 1908	1.75
Nat'l Steel & Wire,pf.	N. Y.	5,000,000	25,778	100	631,561	May 1906	1.75
New Central Coal	Md.	1,000,000	50,000	20	350,000	May 1907	.40
New River Coal, pfd.	W. Va.	4,000,000	37,617	100	225,702	Nov. 1907	1.50
Pacific Coast Borax.	Cal.	2,000,000	19,000	100	2,086,500	Aug. 1905	1.00
Peerless Oil	al	1,000,000	92,000	10	396,320	May 1905	.14
Penna. Salt	Pa.	3,000,000	60,000	50	14,918,000	Apr. 1908	3.00
Penna. Steel, pfd.	Pa.	25,000,000	168,214	100	8,204,493	Nov. 1907	3.50
Phila. Gas, com	Pa.	28,953,029	579,061	50	8,484,336	Nov. 1907	.75
Phila. Gas, pf.	Pa.	6,000,000	120,000	50	2,700,000	Mar. 1908	1.25
Pittsburg Coal, pf.	Pa.	32,000,000	297,010	100	11,434,962	Apr. 1905	1 75
Pocahontas Coll., pf.†	W. Va.	2,800,000	28,000	100	84.000	Jan. 1908	3 00
Pocahontas Coll.,cm†	W. Va.	4,520,000	45,200	100	135,600	Oct. 1907	3.00
Republic I. & S., pfd.	Ill.	25,000,000	204.169	100	6,045,338	Apr. 1908	1.75
Sloss-Sheffield, com.	Ala	10,000,000	100,000	100	1.625,000	Mar. 1908	1.25
Sloss-Sheffield, pf.	Ala	10,000,000	67,000	100	3,517,500	Apr. 1908	1.75
Standard Oil	U. S.	100,000,000	970,000	100	605,272,905	Mar. 1908	15.00
Tenn. C. & I., com	Tenn	22,553,600	225,536	100	3,583,060	Nov. 1907	1.00
Tenn. C. & I., pf.	Tenn	248,000	2,480	100	390,040	Nov. 1907	2.00
Texas & Pacific Coal.	Texas	2,500,000	23,940	100	1,663,830	Dec. 1908	1.50
United Metals Selling	U. S.	5,000,000	50,000	100	5,125,000	Apr. 1908	5 00
U. S. SteelCorp.,cm.	U. S.	550,000,000	5,083,025	100	71,124,566	Mar. 1908	.50
U. S. Steel Corp., pf.	U. S.	360,281,100	3,603,141	100	200,065,718	Feb. 1908	1.75
Va. Carolina Ch., pf.	U. S.	20,000,000	180,000	100	13,260,869	Apr. 1908	2.00
Warwick I. & S.	U. S.	1,500,000	145,581	1	473,138	Nov. 1907	.30
Westmoreland Coal	Pa.	3,000,000	60,000	50	8.730,000	Apr. 1908	2.50

Canada, Mexico, Central and South America.

Name of Company and Location.		Author-ized Capital.	Shares. Issued.	Par Val. $	Dividends. Total to Date.	Latest. Date.	Amt.
Amistad y Conc'rdia.	Mex	$480,000	9,600	50	$258,064	Jan. 1905	$1.71
Batopilas	Mex	9,000,000	446,268	20	† 55,784	Dec, 1907	.12½
British Columbia, c.	B. C.	3,000,000	503,000	5	201,200	Sept. 1907	.40
Buffalo, s	Ont.	1,000,000	900,000	100	189,000	Apr. 1908	.03
Butters' Salvador, g.	Salv	750,000	150,000	5	600,000	Apr. 1905	.25
Coniagas (Cobalt)	Ont.	1,000 000	1,000,000	1	20.000	July 1907	.02
Consolidated M & S.	B. C.	5,500,000	53,552	100	781,885	Nov. 1907	1.25
Crow's Nest Pass	B. C.	3,500,000	140,000	25	2,018,648	July 1907	.62½
Dominion Coal, com.	N. S.	15,000,000	150,000	100	2,700,000	Apr. 1908	1.00
Dominion Coal, pf.	N. S.	3,000,000	30,000	100	‡630,000	Feb. 1908	3.50
Dos Estrellas, g. s.	Mex	150,000	3,000	50	1,020,555	July 1905	13.65
El Oro, g. s	Mex	5,750,000	1,080,000	5	4,600,800	Jan. 1908	.36
Esperanza, s. g.	Mex	2,275,000	455,000	5	7,930,200	Jan. 1908	1.08
Foster Cobalt, s.	Ont.	1,000,000	1,000,000	1	50,000	Jan. 1907	.05
Granby Con	B. C.	15,000,000	135,000	100	2,968,630	Sept. 1907	3.00
Greene Con. Copper.	Mex	8,640,000	864,000	10	6,137,800	Mar. 1907	.40
Greene Con. Gold.	Mex	5,000,000	500,000	10	300,000	July 1905	.20
GreenGold-Silv'r,pfd.	Mex	3,000,000	300,000	10	120,000	Mar. 1907	.40
Guanajuato	Mex	3,000,000	540,000	5	74,250	Oct. 1906	.07
Guggenheim Expl.	Mex	17,000,000	105,000	100	4,222,500	Apr. 1908	2.50
Hinds Con., g.s.c.l.	Mex	5,000,000	5,000,000	1	100,000	Feb. 1908	.02
Kerr Lake, s.	Ont.	3,000,000	600,000	5	480,000	Jan. 1908	.15
LeRoi No. 2, g	B. C.	3,000,000	120,000	25	774,000	Mar. 1908	.48
McKinley-Darragh,s	Ont.	2,500,000	2,000,000	1	180,000	Jan. 1908	.04
Mexican Coal & Coke	Mex	5,000,000	50,000	100	600.000	Dec. 1905	3.00
Mex. Con. M. & S. Co.	Mex.	2,500,000	240,000	10	660,000	Mar. 1908	.25
Mex. Con. of Am.	Mex	2,000,000	2,000,000	1	3,025,000	Mar. 1908	.02
Mines Co. of Am.	C. A.	1,500,000	150,000	10	2,682,000	Mar. 1908	.10
N. Y. & Hond. Ros.	Ont.	6,000,000	1,200,000	5	1,680,000	Apr. 1908	.15
Nipissing, s	B. C.	1,500,000	1,300,000	1	351,000	Dec. 1904	1.00
North Star	N. S.	5,000,000	49,876	100	1,087,856	Apr. 1908	1.50
N. S. St. & Coal, com.	N. S.	1,030,000	10,300	100	437,750	Apr. 1908	2.00
N. S. St. & Coal, pf.	N. S.	250,000	2,500	100	8,630,000	Dec. 1907	20.00
Penoles*	Mex	500,000	206,989	1	5,580	Sept. 1906	.01½
Platanillo	Mex	1,000,000	958,000	1	327,082	Apr. 1906	.02
Reco, g. s.l	Ont.	1,500,000	1,500,000	1	120,000	Jan. 1907	.08
Silver Queen, s.	B. C.	500,000	500,000	1	575,000	Dec. 1904	.06
Slocan Star	Mex	1,000,000	10,000	100	.....	Apr. 1908	1.50
Tezuitlan Copper	N. F.	1,000,000	89,000	2	21,360	Jan. 1905	.48
Tilt Cove, c.	Ont.	1,000,000	1,000,000	1	80,000	Mar. 1907	.04
Tretheway, s	B. C.	940,000	180,000	5	136,800	Dec. 1904	.24

*Mexican Currency. †Since reorganization. ‡Since August, 1905.

CHEMICALS, MINERALS, RARE EARTHS, ETC.—CURRENT WHOLESALE PRICES.

ABRASIVES—		
Bort, good drill quality, carat		$85.00
Carborundum, f.o.b. Niagara Falls, powd	lb.	.08
Grains	"	.10@.17
Corundum	"	.07@.10
Crushed Steel, f.o.b. Pittsburg	"	.05¾@.06
Emery, in kegs: Turkish flour	"	.01½@.02½
Grains	"	.03½@.04½
Naxos flour	"	.01½@.02½
Grains	"	.03½@.04½
Chester flour	"	.01½
Grains	"	.03½@.04½
Peekskill, f.o.b. Easton, Pa., flour	"	.01½@.01½
Grains, in kegs	"	.02½@.02½
Garnet, per quality	sh. ton	25.00@35.00
Pumice Stone, Am. Powd. 100 lb.		1.60@2.00
Italian, powdered	"	.01¼@.01½
Lump, per quality	"	.03@.20
Rottenstone, ground	"	.02½@.04½
Lump, per quality	"	.05@.25
Rouge, per quality	"	.05@.30
Steel Emery, f.o.b. Pittsburg	"	.07½@.07¾
ACIDS—		
Acetic 28%	lb.	.026@.03
Boric	"	.08@.08¼
Hydrofluoric, 30%	"	.02¾@.03
" 48%	"	.06
" 60%	"	.10
Hydrochloric acid ,20°, per lb		1.25@1.50
Nitric acid, 38°	per lb.	4.25@4.62½c.
Sulphuric acid, 50°, bulk, per ton		$12 up.
60°, 100 lb. in carboys		.85@1.12½
60°, bulk, ton		16.00@18.00
66°, 100 lb. in carboys		1.00@1.25
66°, bulk, ton		18 00
Oxalic	"	.07@.07¾
ALCOHOL—Grain 95%	gal.	2.63
Denatured		.39@.45
Refined wood, 95@97%	"	.39@.45
ALUM—Lump	100 lb.	$1.75
Ground	"	1.85
Chrome Alum	lb.	.05½@.06
ALUMINUM—Sulphate, com'l.	"	1.10@1.75
AMMONIA—24 deg. lb		.04½@.05½
" 26 " "		.04¾@.05¾
AMMONIUM—		
Bromide	lb.	.23
Carbonate	"	.07½@.08
Muriate grain	"	.05¾@.06½
Lump	"	.09@.09½
Sulphate, 100 lb		3.05@3.10
Sulphocyanide com	"	.30
" " chem. pure	"	.40
ANTIMONY—needle, lump lb		.05@ 06
ARSENIC—White	"	.04¾@.05¼
Red	"	.07½@.07¾
ASPHALTUM—		
Barbadoes	per ton	40.00@80.00
West Indies	"	20.00@60.00
Egyptian	lb.	.12@.14
Gilsonite, Utah ordinary	per ton.	35.00
Trinidad	"	28.00@30.00
California	"	21.00@27.00
BARIUM—		
Carb. Lump, 80@90%	lg. ton.	30.00@35.00
Precipitated 96@98%		31.50@35.00
Powdered, 80@90%	lb.	.02@.02½
Chloride com'l	ton.	38.00@40.00
Nitrate, powdered, in casks	lb.	.05½@.06
Blanc Fixe	per lb.	.02¾
BARYTES—		
Am. Ground	sh. ton.	14.00@21.00
Floated	"	22.00
Foreign floated	"	19.50@22.50
BISMUTH—Sub-nitrate	lb.	1.50
BLEACHING POWDER—35%, 100 lb		1.25@1.40
BLUE VITRIOL—(copper sulphate), carload, per 100 lb		5.00
BONE ASH	lb.	.02½@.04
BORAX	"	.04½@.05½
CALCIUM—Acetate, gray	"	2.25@2.30
Acetate, brown	"	1.40@1.45
Carbide, ton lots f.o.b. Niagara Falls, N. Y., for Jersey City, N. J.	sh. ton.	65.00
Chloride, f.o.b. N. Y	"	14.75@19.75
CEMENT—		
Portland, Am. 500 lb	bbl.	1.55@1.60
Foreign	"	2.25@2.90
"Rosendale," 300 lb	"	.85
(in sacks)		.65
Slag cement	"	.75@1.25
CHROME ORE—		
New Caledonia 50% ex. ship N. Y	per lg. ton	17.50@20.00
Bricks, f.o.b. Pittsburg, M	"	175.00
CLAY, CHINA—Am. common ex-dock, N. Y	"	8.50@9.00
Foreign	"	10.00@17.50
COBALT—Oxide	lb.	1.45
COPPERAS—Bulk	100 lb.	$0.55
In bbls	"	.65@.75
In bags	"	.60@.70
CRYOLITE	lb.	.06½@.06¾
FELDSPAR—Ground best sh. ton.		10.50@15.00
FIRE BRICK—		
American	per M.	30.00@40.00
Imported	"	30.00@45.00
St. Louis No. 1	"	18.00
" No. 2	"	15.00
Extra	"	20.00@23.00
FIRE CLAY—F. o. b. St. Louis.		
St. Louis, extra quality	per ton	5.00
" ordinary	"	2.50
FLUORSPAR—		
Domestic f.o.b. shipping port:		
Lump	lg. ton.	8.00@10.00
Ground	"	11.50@13.50
Foreign crude ex. dock		8.00@10.00
FULLER'S EARTH—Lump, 100 lb.		.75@.85
Powdered	"	.75@.85
GRAPHITE—Ceylon		
Flying dust, finest to best	lb.	.01@.04
Dust	"	.01¾@.05
Chip	"	.02¾@.07½
Lump	"	.04@ 10
Large lump	"	.07@.10
GYPSUM—		
Fertilizer	sh. ton.	5.00
Ground	sh. ton.	4.00@7.00
INFUSORIAL EARTH—		
Ground Am. best	lb.	.01¾
French	lg. ton.	56.00
German	lb.	.02½@.02¾
LEAD—Acetate (sugar of) brown	lb.	.07¾
Nitrate, com'l	"	.08½@.09¼
MAGNESITE—Greece.		
Crude (95%)	lg. ton.	8.00@10.00
Calcined, powdered	sh. ton.	30.00@40.00
Bricks, domes, per qual. f.o.b. Pittsburg	M.	160@200
MAGNESIUM—		
Chloride, com'l	100 lb.	.80@1.00
Sulphate (Epsom salt)	100 lb.	.85@1.00
MANGANESE—		
Foreign, crude, powdered:		
70@75% binoxide	lb.	.01@.01¼
75@85% binoxide	"	.01¼@.01½
85@90% binoxide	"	.01½@.05
90@95% binoxide	"	.06¼
Ore, 80%-85%	sh. ton.	18.00@40.00
MARBLE—Flour	sh. ton.	8.50@10.00
MINERAL WOOL—		
Slag, ordinary	"	19.00
Selected	"	25.00
Rock, ordinary	"	32.00
Selected	"	40.00
MONAZITE SAND—		
Guar. 97%, with 5% Thorium oxide, nominal	lb.	.08 and up.
NICKEL—		
Oxide, crude, lb. (77%) for fine metal contained		.47
Sulphate, single	lb,	.09@.11
" double	"	.06½@.08
NITRATE OF SODA—100 lb. 95% for '07		2.45
95% for 1908		2.45@2.50
95% for 1909		2.40
96% is 5c higher per 100 lb.		
OZOKERITE—best	lb.	.14@.17
PAINTS AND COLORS—		
Litharge, Am. powdered	"	.06½@.06¾
English glassmakers'	"	.08¼@.08½
Lithopone	"	.03½@.07
Metallic, brown	sh. ton.	16.50@22.00
Red	"	14.00@18.00
Ocher, Am. common	"	8.50@9.00
Best	"	16.00
Dutch, washed	lb.	.02¼@.03
French, washed	"	.01½@.02½
Paris green, pure bulk	"	.26
Red lead, American	"	.06½@.06¾
Foreign	"	.08½@.08¼
Turpentine, spirits bbl., per gal.		.58
White lead, Am., dry	lb.	.05½@.06
American, in oil	"	.06½@.06¾
Foreign, in oil	"	.10½@.10¾
Zinc white, Am. extra dry	"	.05½@.05¾
French, red seal, dry	"	.08¼@.08½
" Green seal, dry	"	.10½@.10¾
PHOSPHATES—Acid		.65@70c per unit
*Fla., hard rock		10.25@10.50
land pebble 68%		5.25@5.50
†Tenn., 78@80%		7.00@8.00
75%		6.25@6.75
68@72%		5.25@5.50
‡So. Car. land rock		6.75@7.00
" " river rock		7.00@7.25
POTASSIUM—		
Bicarbonate crystal	lb.	$.08½@.09
Powdered or granulated	"	.09@.09½
Bichromate, Am	"	.08¾@.09
Scotch	"	.10¾
Bromide	"	.15@.17
Carbonate (80@85%)	"	.03½@.04
Caustic, ordinary	"	.04½@.05¼
Elect. (90%)	"	.05½@.06
Chloride (muriate), 100 lb		1.90
Chlorate, powdered	"	.09½@.09¾
Crystals	"	09@09½
Cyanide (98@99%)		
Carloads (30,000 lb.)	"	18c.
5-ton lots	"	18½c.
Less than 5 tons	"	19c.
Kainite, long ton, bulk, 8.50; bags, 9.50.		
Permanganate	lb.	.09½@.10
Prussiate, yellow	"	.15@.16
Red	"	.33@.38
Sulphate	100 lb.	2.18½@2.21½
PYRITE—		
Domestic, non-arsenical, furnace size, f.o.b. mines	per unit	11@11½c.
Domestic, non-arsenical, fines, per unit, f.o.b. mines		10@10½c.
Imported non-arsenical, furnace size, per unit		.12½@.13
Imported, arsenical, furnace size, per unit		.12@.12½
Imported fines, arsenical, per unit		.08½@.09
" " non-arsenical, per unit		10½@11c.

Pyrite prices are per unit of sulphur. An allowance of 25c. per ton is made when delivered in lump form.

SALT—N. Y. com. fine 280 lb. bbl.		.72@1.18
N. Y. agricultural	sh. ton.	3.80@4.50
SALTPETER—Crude	100 lb.	4.50@5.00
Refined, crystals	"	5.00@6.00
SILICA—		
Ground quartz, ord'ry	lg. ton	10.00@15.00
Silex	"	13.00@40.00
Lump Quartz	"	5.00@6.00
Glass sand	"	2.75
SILVER—Nitrate, crystals	oz.	.35½@.39
SODIUM—		
Acetate	lb.	.04¼@.04¾
"Alkali," per 100 lb., 58/48		.80@.87½
Bicarb. soda, per 100 lb		1.20@1.50c.
Soda, caustic, per 100 lb., 76/60		1.75@1.85
" " powdered		.02¾@.03½
Salt cake, per 100 lb, bulk		.40
" " bbl		.65@.85
Soda, monohydrate, per lb		1.4@1.75c.
Bichromate	lb.	.07½@.07½
Bromide	"	.15@.17
Chlorate com'l	"	.09@.09½
Cyanide ("100% KCN")		
Carloads (30,000 lb.)	"	18c.
5-ton lots	"	18½c.
Less than 5 tons	"	19c.
Hyposulphite, Am	"	1.35 up
German	"	1.60@1.70
Phosphate	100 lb.	2.10@2.30
Prussiate	"	.09½@.09½
Sal soda, f.o.b. N. Y	100 lb.	.65@.70
Foreign, f.o.b. N. Y	"	.80@1.00
Silicate, com'l	100 lb.	.80@1.15
Sulphate, com'l, (Glauber's salt)	100 lb.	.60@.75
" " calcined		.65@.85
STRONTIUM—Nitrate	lb.	.08@.08½
SULPHUR—		
Louisiana (prime) to New York, Boston or Portland	lg. ton	22.00
To Philadelphia or Baltimore	"	22.00
Roll	100 lb.	1.85@2.15
Flour	" "	2.00@2.40
Flowers, sublimed	" "	2.20@2.60
TERRA ALBA—French & Eng.	100 lb.	.65@1.00
TALC—Domestic	sh. ton.	15.00@25.00
French	"	16.00@25.00
Italian, best	"	35.00@40.00
TIN—Bi-chloride, 50%	lb.	.09¾
Crystals	"	.19½ up
Oxide, lb		.33@.35
URANIUM—Oxide	"	3.50
ZINC—		
Chloride solution, com'l 20°	"	.02½
Chloride, granular	"	.04½@.05
Dust	"	.05½@.06
Sulphate	"	2.15 up

*F. o. b. Florida or Georgia ports. †F. o. b. Mt. Pleasant. ‡On vessel Ashley River, S. C.

NOTE—These quotations are for ordinary wholesale lots in New York unless otherwise specified, and are generally subject to the usual trade discounts. In the cases of some of the important minerals, such as phosphate rock, pyrites, and sulphur, in which there are well established markets, the quotations fully represent the latter. But in the cases of some of the minor mineral products, the quotations represent what dealers ask of consumers and not what producers can realize in selling their outputs as matters of private contract.

THE MINING INDEX.

The editors of this paper read all the important publications of the world that relate to mining and the treatment of minerals. This index is published as a reference for all interested and to make it impossible for readers of the ENGINEERING AND MINING JOURNAL to miss any important article published anywhere.

We will undertake to furnish a copy of any article (if in print) in the original language, for the price quoted. Where no price is quoted the cost is unknown. These papers are not kept in stock, but must be ordered from the publisher; hence there will be some delay for foreign papers.

No accounts can be opened for these small amounts, but remittance must be sent with order. For the convenience of those making small but frequent remittances, coupons are furnished at the following prices: 20 cents each, six for $1.00, thirty-three for $5.00 and one hundred for $15.00. This arrangement will be especially appreciated by foreign readers and men in distant mining camps. Where remittances are made in even dollars we will return the excess over an order in coupons upon request.

ALUMINUM

5786—REDUCTION—On the Direct Reduction of Alumina by Carbon. R. S. Hutton and J. E. Petavel. (Electrochem. and Met. Ind., Mar., 1908; 3½ pp.) This article, which forms a part of the original paper delivered by the authors before the Royal Society of London, discusses the general subject and then gives the results of experiments made to determine the temperature at which alumina begins to be reduced by carbon; the nature of the aid that the auxiliary metal in aluminum gives to the carbon in this reduction; and what precautions should be taken so as to prevent the formations of aluminum carbide. 40c.

ANTIMONY

5787—PERU AND BOLIVIA—Antimony Mining in Peru and Bolivia. G. Preumont. (Min. Journ., Mar. 7, 1908; ¾ p.) Discusses the antimony deposits in these countries. 40c.

ASPHALT

5788—OKLAHOMA—The Asphalt Deposits of Oklahoma. Charles N. Gould. (Petrol. Rev., Mar. 14, 1908; 1¼ pp.) Briefly discusses the manner of occurrence, the composition of the asphalt, and the difficulties of exploiting these deposits. 40c.

BISMUTH

5789—DETERMINATION of Small Quantities of Bismuth. Herbert W. Rowell. (Journ. Soc. Chem. Ind., Feb. 15, 1908; 3 pp.) Different points in the analysis of substances containing bismuth are discussed and then the iodide method of determining bismuth in ores, mattes, etc., is described in detail. 80c.

CEMENT

5790—CEMENT MILL—The New Mill of the California Portland Cement Company. (Eng. Rec., Mar. 7, 1908; 3 pp.) The equipment and arrangement of this new mill at Colton, Cal., which has a capacity of 2500 bbls. of cement per day, is described. 20c.

5791—CEMENT PLANT—A New Rotary Kiln Cement Plant. (Engineer, Lond., Feb. 28, 1908; 2¾ pp.) The construction and operation of the rotary kiln, made by F. L. Smidth & Co., of Copenhagen, is described, together with the equipment of the rest of the cement plant at Greenhithe, England, belonging to I. C. Johnson & Company. 40c.

5792—KILNS—Calculating the Heat Balance of Lime Kilns. Robert Schorr. (Eng. and Min. Journ., Mar. 21, 1908; 2 pp.) The method of calculating the heat balance for different kinds of lime kilns is explained very clearly. 20c.

COAL AND COKE

5793—AERIAL ROPEWAY PLANT at the Elliott Collieries, South Wales. (Iron and Coal Tr. Rev., Mar. 13, 1908; ¾ p.) Description and views of a ropeway installation where the spoil bank, or dump, is formed on entirely new lines and without the introduction of high and costly structures. 40c.

5794—WESTPHALIA—Excursion en Westphalie. J. Wuillot. (Rev. univ. des Mines, Dec., 1907; 16½ pp.) Describes the modes of operation at a number of the Westphalian collieries. $1.00.

5795—ALBERTA—International Coal & Coke Company, Coleman, Alberta. George A. Ohren. (Can. Min. Journ., Mar. 1, 1908; 1¼ pp.) The present work being done by this company at its coal mine near Coleman, Alberta, is outlined and considerable general information regarding the extent of the workings, the surface equipment, the geological occurrence of the coal, the amount of coal developed, and its quality is given. 20c.

5796—ANALYSIS—Pure Coal as a Basis for the Comparison of Bituminous Coals. W. F. Wheeler. (Paper read before the A. I. M. E., July, 1907; 12 pp.) The subject is discussed in detail; the author shows by means of tables, giving the analysis of Illinois and Indiana coals, the feasibility of the method.

5797—BELGIUM—Le Sondage de Bertaimont, á Mons. J. Cornet. (Ann. de la Soc. Geol. de Belgique, Nov. 15, 1907; 6 pp.) Outlines the evidence secured by this borehole which was sunk 334 meters to test a coal seam.

5798—MINE FILLING—Le Remblayage hydraulique. A. Wildiers. (Rev. univ. des Mines, Dec., 1907; 52½ pp.) Continuation of article previously mentioned in this Index. Discusses the application of the hydraulic system of transporting filling material in coal mines, and gives data of costs at a number of mines. $1.

5799—BELGIUM—Sur la Structure du Bassin houiller du couchant de Mons. J. Cornet. (Ann. de la Soc. Geol. de Belgique, Nov. 15, 1907; 7 pp.) A discussion of certain disputed points related to the geological structure of this coal basin.

5800—BOILERS—Stirling and Other Water-Tube Boilers as Applied to Collieries and Coking Plant. J. M. Johnson. (Coll. Guardian, Feb. 14, 1908; 1 p.) The advantages of different forms of water-tube boilers are discussed in this abstract of the paper read before the Manchester Geological and Mining Society. 40c.

5801—BRIQUETTING—New Method of Briquetting Fuel. (South. Engr., Feb., 1908; ½ p.) In this editorial the Shedlock and other methods of briquetting fuel are discussed. 20c.

5802—BRIQUETTING of Fuels in British Columbia. G. J. Mashek. (Can. Min. Journ., Jan. 15, 1908; 2½ pp.) The briquetting plant of the Pacific Coal Co., at Bankhead, Alberta, is described quite fully. The Mashek press is discussed and the general procedure at this plant is stated. Some figures regarding the cost of installing the plant and operating it are given. 20c.

5803—BRITISH COALFIELDS—The South Derbyshire and Leicestershire Coalfield. (Coll. Guardian, Feb. 21, 1908; ¾ p.) The physical structure of coalfields in general and this coal field in particular is discussed. 40c.

5804—CALORIMETER—Radiation Correction for the Coal Calorimeter. Ernest H. Peabody. (Stevens Inst. Indicator, Jan., 1908; 7 pp.) The derivation of this formula is given and the general subject of calorimeters briefly discussed. 60c.

5805—CANADA—In the Rocky Mountains. D. B. Dowling. (B. C. Min. Rec., Feb., 1908; 1¾ pp.) This report contains many details of the coal areas north of the Saskatchewan, and notes on the Athabaska valley. 20c.

5806—COAL DUST FUEL—(Engineer, Feb. 21, 1908; ¾ p.) Directs attention to the use of fine coal produced at pits, giving two systems in use. 40c.

5807—COAL HANDLING—Temperley Grab Transporters at the New Admiralty Coaling Pier at Portland. (Elec. Rev., Feb. 28, 1908; 1½ pp.) The operation and construction of this English loading crane of gantry type is described. 20c.

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5830—MAGNETIC CLEANING OF COAL—The Possibility of Reducing the Ash-content of Coal by Electro-Magnetic Means. E. Prost. (Coll. Guardian, Feb. 21, 1908; ½ p.) In this translation of the original paper by E. Prost, in the Bull. Soc. Chim. Belg., a series of experiments in which a Wetherill magnetic separator was used to remove ferruginous gangue from the coal are discussed and the superiority of magnetic separation over washing, in treating certain coals, is suggested. 40c.

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5852—STORAGE—The Weathering of Coal. S. W. Parr. (Univ. of Ill. Bull. No. 17, Aug. 26, 1907; 25 pp.) Gives opinions expressed during past years by various authorities, records experimental work, and summarizes the information so obtained.

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5868—PRODUCTION—The Future of Copper. John T. Morrow. (Eng. and Min. Journ., Feb. 29, 1908; 1¾ pp.) The future production of copper is predicted up to the year 1929.

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5871—SLIMES TREATMENT—Electrometallurgical Treatment of Copper Slimes, D. Hollis, F. P. Lannon, T. W. Quayle and P. D. Grommon. (Bull. Colo. Sch. Mines, Jan., 1908; 18 pp.) The different leaching processes for extracting copper are outlined; the method of treating slimes at the Washoe smelter, Anaconda, Mont., is described; the reasons for preferring an electrolytic method for the treatment of copper ores are stated and then the results of a series of experiments made to determine the best method of roasting the ore, of the conditions giving the best results in leaching, and of depositing copper from solutions by means of electrolysis are stated. The adaptability of the method proposed by the authors, that of giving the ore a dead roast, then leaching with sulphuric acid (¼ per cent. solution), with subsequent settling and decantation of the solutions and electrolytic deposition of the copper from the decanted solutions, is discussed and an estimate of the cost given. 60c.

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GOLD AND SILVER

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5878—CYANIDATION in Nevada. B. Hunt. (Min. and Sci. Press, Feb. 22, 1908; 1¼ pp.) The treatment of the Goldfield ore, proposed by Mr. King and already mentioned in this Index, is discussed, and information regarding the roasting, chloridizing and filtering is given. 20c.

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5880—CYANIDATION of Ores. W. A. Hendryx. (Proc. Colo. Sci. Soc., Vol. IX., pp. 5-20.) Deals with the mechanical handling of ores and the different apparatus employed in cyanidation. Illustrated.

5881—CYANIDATION—Treatment of Slimes in Black Hills, South Dakota. S. E. Bennett. (Min. Sci., Feb. 27, 1908; ¾ p.) The construction of the Merrill slime filter, and the zinc-dust precipitation of the gold from the cyanide solutions are described briefly. 20c.

5882—CYANIDE PROCESS—History of the Cyanide Process. Fredk. Danvers Power. (Min. and Sci. Press, Mar. 7, 1908; ½ p.) The work in experimenting with cyanide solutions done by W. A. Dixon, of Sydney, Australia in 1877 is described. 20c.

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5891—NEW MEXICO—Genesis of the Lake Valley Silver-Deposits. Charles R. Keyes. (Paper read before the A. I. M. E., July, 1907; 31 pp.) The general geologic features of this region in southwestern New Mexico, the occurrence of the orebodies, the mineralogic characteristics of the ore and its genesis are discussed in detail.

5892—ONTARIO—The Montreal River District Mining Prospects. Alex. Gray. (Min. Wld., Mar. 14, 1908; 1¾ pp.) Briefly describes and illustrates the conditions in the new silver district north-west of Cobalt and mentions some of the discoveries. 20c.

5893—ORE TREATMENT MACHINE—Procédé combiné d'Amalgamation, Cyanuration et Concentration des Minerais d'Or et d'Argent. M. Dekeyser and G. Verbeke. (Rev. univ. des Mines, Dec., 1907; 8 pp.) Describes the construction and operation of a machine which combines the processes of grinding, amalgamation, cyaniding and concentration, and gives costs. $1.00.

5894—ORIGIN OF THE GOLD in Banket. J. S. Curtis. (Journ. Chem. Met. and Min. Soc. of South Africa, Jan., 1908; 4½ pp.) The arguments brought forward by Prof. J. W. Gregory to support the sea-beach origin of the gold deposits of the Rand are discussed and some of Prof. Gregory's theories assailed, for the author does not agree with the placer-beach origin of the gold on the Rand. 60c.

5895—PLACER MINING in New Zealand. E. M. Thorniley. (Am. Min. Rev., Mar. 7, 1908; ¾ p.) The methods of working placer-gold deposits in the Otago district are outlined. In the first instalment, the grade of the sluice boxes, and the methods of paving the sluices and of constructing the undercurrents are described. 20c.

5896—PLACER MINING in New Zealand. E. M. Thorniley. (Am. Min. Rev., Mar. 14, 1908; 1 p.) Second instalment, describing the methods of hydraulicking and ground-sluicing used in New Zealand, and discussing the carrying capacity of the different sluices. 20c.

5897—PRODUCTION OF GOLD—Will the Production of Gold in the World Keep Pace with the Increasing Demands of Commerce and Trade? Waldemar Lindgren. (Proc. Am. Min. Congress, Nov. 16, 1907; 7 pp.) The past, present and future production of different gold district of the world is discussed.

5898—RAND MINING—Actual Earning Power of the Rand Mines. George A. Denny. (Eng. and Min. Journ., Mar. 21, 1908; 2 pp.) The methods of keeping the cost accounts are described, and the general conditions of the industry are discussed at length. 20c.

5899—RAND MINING—Excessive Equipment Expenditures on the Rand. George A. Denny. (Eng. and Min. Journ., Mar. 7, 1908; 2¼ pp.) The cost of equipping a mine on the Rand is stated and different methods of decreasing the cost are suggested. The width of stope to be used is discussed and different examples of excessive equipment are enumerated. 20c.

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5901—RAND MINING—The Commercial Aspect of Rand "Profits." George A. Denny. (Eng. and Min. Journ., Feb. 29, 1908; 2½ pp.) An abstract of the part of the original article, appearing in the *Mining Journal*, that deals with the working costs, capital redemption, interest charges and deferred dividends. 20c.

5902—REFINING—Gold Refining. Donald Clark. (Aust. Min. Stand., Jan. 22, 1908; 2¼ pp.) Concludes a series of able articles on the refining of gold bullion, mainly derived from the precipitation of cyanide solutions. 20c.

5903—RHODESIA—Mining in Rhodesia. E. H. Garthwaite. (Min. and Sci. Press, Mar. 14, 1908; ¾ p.) Some general information regarding social rather than mining conditions in Rhodesia is given by the former resident mining engineer for the chartered company. 20c.

5904—SLIMES TREATMENT—The Utilization of Waste Heat in Slimes Settlement. A. Salkinson. (Journ. Chem. Met. and Min. Soc. of South Africa, Nov., 1907; 3 pp.) Mr. Salkinson replies to the discussion of his paper. 60c.

5905—SOUTH AFRICA—Report on Lydenburg. (So. African Mines, Feb. 8, 1908; ½ p.) This abstract, from the Report of the Transvaal Geological Survey for 1906, describes the geology, lithological features of the ore, and the horizons that are metalliferous in this, the second largest gold district in South Africa. 20c.

5906—SOUTH AFRICA—The Pietersburg-Marabastad Goldfields—II. and III. (So. Afr. Mines, Feb. 1 and 8, 1908; 3 pp.) In these instalments the different mines in the district are described; also the treatment plant at the property of the Oceana company. 40c.

5907—TASMANIA—The Mangana Goldfield. W. H. Twelvetrees. (Geol. Surv. of Tasmania, Bull. No. 1, 1907; 36 pp.; 3 maps.) Describes the geology of this gold district near Fingal, Tasmania, which is one of the oldest districts at present unimportant; the gold occurrence of different mines in the district is described and the future of the district discussed.

5908—TUBE MILLS—Mechanical Efficiency of Tube Mills. Frank A. Lockwood. (Eng. and Min. Journ., Mar. 21, 1908; ⅓ p.) The power consumed by tube mills is discussed. 20c.

5909—UTAH—Daly-West Mine and Mill. Robert B. Brinsmade. (Mines and Minerals, Mar., 1908; 4 pp.) Describes the orebodies, the methods of mining, the surface equipment, and the method of concentrating the ore. 20c.

5910—UTAH—Mining and Milling at Stockton, Utah. Robert B. Brinsmade. (Eng. and Min. Journ., Mar. 21, 1908; 2 pp.) The

geology of the region, the ore occurrence at the Honorine mine and the methods of mining and milling the ores at that property are described. 20c.

5911—UTAH—The Geology of Stateline District, Utah. (S. L. Min. Rev., Mar. 15, 1908; 2½ pp.) History of mining and geology of this comparatively new district. Illustrated. 20c.

GRAPHITE

5912—CANADIAN GRAPHITE, Modes of Occurrence of. H. P. H. Brumell. (Can. Min. Journ., Mar. 15, 1908; 2¼ pp.) Paper read at Ottawa meeting, 1908, Can. Min. Inst. This discusses the mode of occurrence of graphite in different parts of Canada, and gives information regarding the quality of the graphite mined at different places.

5913—DEFLOCCULATED GRAPHITE—The Deflocculation of Non-Metallic Amorphous Bodies. Edward Goodrich Acheson. (Proc. Am. Min. Congress, Nov. 16, 1907; 9 pp.) Some notes are given on the nature of different clays for use in making graphite crucibles; the method of making deflocculated graphite is described in detail and its uses discussed.

GYPSUM

5914—OCCURRENCE AND USE—Gypsum: Where Found, its Use and Its Manufacture. C. O. Bartlett. (Proc. Am. Min. Congress, Nov. 16, 1907; 4 pp.) The commercial occurrences of gypsum are reviewed, the methods of milling gypsum rock outlined, and the use of gypsum stated.

IRON AND STEEL

5915—ALABAMA—Brown-Ore Mining in the Russellville District, Alabama. F. Wm. Hausmann. (Stevens Inst. Indicator, Jan., 1908; 6 pp.) The ore occurrence is outlined and the methods of mining described. 60c.

5916—ALLOYS—Special Alloys for the Steel Industry. (Iron and Coal Tr. Rev., Mar. 13, 1908; 2 1/3 pp.) This instalment discusses the use of alloys of tungsten, molybdenum, vanadium, phosphorus, manganese, etc., in steel making. 40c.

5917—ALPINE IRON INDUSTRY—Montanistische Forschungsreisen durch die Alpenländer. A. Müllner. (Oest. Zeit. f. B. u. H., Feb. 1 and 8, 1908; 7 pp.) A brief historical review of the iron industry in Alpine countries during the earliest times. 60c.

5918—AUSTRALIA—Iron Making in Australia. A. Selwyn Brown. (Eng. and Min. Journ., Mar. 21, 1908: 1 p.) The different iron and steel plants in the Commonwealth are briefly described and the extent of the industry stated. 20c.

5919—BLAST FURNACE—Remodeling a South Staffordshire Blast Furnace. (Iron and Coal Tr. Rev., Mar. 13, 1908; ¾ p.) Method employed in the reconstruction of an old blast furnace, in order to bring it as near as possible to the standard of an up-to-date plant. 40c.

5920—BLAST FURNACE SLAG—The Manufacture of Concrete Brick From Blast Furnace and Other Slag. Josiah Butler. (Iron Tr. Rev., March 19, 1908; 4 /3 pp.) Abstract of a paper persented before the Staffordshire I. & S. Inst., Jan. 18, 1908. Describes the method used at the Landore works of Messrs. Baldwin, Ltd., England, of making such brick. The granulating plant, the grinding of the lime, and the uniformity of the slag are discussed, and the cost is given. The article is discussed by other members. 20c.

5921—BLAST FURNACE SMELTING—Preparation of Materials for the Blast Furnace. David Baker. (Eng. and Min. Journ., Mar. 21, 1908; 1⅞ pp.) Discusses the effect of different impurities in iron ore, especially sulphur, the cost of smelting, and the advantages of sintering fine ore in rotary kilns either with or without the addition of some substance to act as a burner 20c.

5922—BRITISH MINING ROYALTIES—The Mining Royalty Burden on British Iron and Steel. T. Good. (Cassier's Mag., Mar., 1908; 3 pp.) Discusses the effect that the letting of leases without Government restriction regarding the royalties charged has upon the British steel industry. 40c.

5923—CASTING—Measuring the Capacity of Ladles. A. C. Hemist. (Foundry, Mar., 1908; 3¾ pp.) Describes a method measuring the capacity of ladles by the use of a gage bar and gives rules for calculating the contents of ladles so that the expansion of the metal with heat is allowed for. 20c.

5924—CASTINGS—Making of Steel Castings in Ontario Iron and Steel Plant. (Can. Machy., Mar., 1908; 4½ pp.) The general equipment of this new plant at Welland, Ontario, is outlined; the construction of the basic open-hearth furnaces used is discussed; the details of the design of the oil burner used in firing these furnaces are given; and the method of casting is described. 20c.

5925—CHARGING MACHINES for Cupolas. G. R. Brandon. (Iron Tr. Rev., Mar. 12, 1908; 1¾ pp.) The charging machine, manufactured by the Whiting Foundry Equipment Company, Harvey, Ill., is described and its operation discussed. 20c.

5926—CHROME IRON MINING In Canada. H. F. Strangways. (Paper read before Can. Soc. of Civil Eng., Dec., 1907; 16 pp.) Discusses the geology, methods of mining and milling, and contains information of interest regarding the operating companies of the district around Black Lake, township of Coleraine.

5927—CHROME IRON MINING and Milling in Canada. H. F. Strangways. (Eng. and Min. Journ., Mar. 21, 1908; 2½ pp.) An abstract of the original paper mentioned above. 20c.

5928—CORROSION—Influence of Stress Upon the Corrosion of Iron. (Eng. Times, Jan. 16, 1908; 2 pp.) Discusses the influence of stress upon the electromotive force of iron, and hence upon its corrosion. Records experiments and deductions therefrom. From Proc., Am. Soc. for Testing Materials. 20c.

5929—CORROSION—Relative Corrosion of Wrought Iron and Soft Steel Pipes. R. N. Thompson. (Iron Tr. Rev., Mar. 5, 1908; 4 pp.) The subject is discussed and the results of a series of experiments, which show that steel pipes are slightly less subject to corrosion by warm water than wrought-iron pipes, are given. 20c.

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5931—HIGH SULPHUR COKE—Making Basic Iron With High Sulphur Coke. Randolph Bolling. (Iron Age, Mar. 5, 1908; 1¾ pp.) Discusses the maximum percentage of sulphur permissible in coke that is to be used in blast furnaces making pig iron for basic open-hearth furnaces. 20c.

5932—KRUPP WORKS at Rheinhausen. (Iron Age, Feb. 27, 1908; 11 pp.) In this article, translated from *Stahl und Eisen*, Oct., 1907, the blast-furnace equipment, the coke ovens, the bessemer and open-hearth steel works, and the two blooming and six finishing mills are described. 20c.

5933—MALLEABLE CASTINGS—Production of Malleable Castings—II. Richard Moldenke. (Foundry, Mar., 1908; 3½ pp.) Sets forth the characteristics of malleables and their physical and chemical properties; gives methods of testing. 20c.

5934—ONTARIO—Moose Mountain Iron Range, with Special Reference to the Properties of Moose Mountain, Ltd. Norman L. Leach. (Can. Min. Journ., March 15, 1908; 1p.) A paper read before the Ottawa meeting of Can. Min. Inst. Discusses the general conditions in this district of Ontario, north of Nipissing, especially at the mine mentioned in the title.

5935—ONTARIO—The Atikoken Iron Company. L. B. Orchard. (Can. Min. Journ., Mar. 1, 1908; 3½ pp.) A description of this company's plant, embracing stock-shed, furnace, roaster, ovens and power house. Relates difficulties encountered in construction owing to wet ground. 20c.

5936—ONTARIO—The Iron Ores of Ontario. A. B. Willmott. (Can. Min. Journ., March 15, 1908; 7¼ pp.) Gives statistics of the iron production from 1897 to 1907; describes the character of the ores and discusses their geologic occurrence and also their manner of formation. The occurrence at some of the mines is outlined. 20c.

5937—PHOSPHOROUS IN IRON—Beitrag zum Einfluss des Phosphors auf das System Eisen-Kohlenstoff. F. Wüst. (Metallurgie, Feb. 8, 1908; 20 pp.) Describes the apparatus used, and give results of a long series of experiments into the properties, particularly the cooling curve, of a number of irons of varying, but ascertained, phosphorous contents. The structure of the irons was also studied microscopically. 40c.

5938—REPORTS ON PLANTS—Outline for a Report on an Iron and Steel Plant. (Mines and Min., Feb. 28, 1908; 1⅛ pp.) This enumerates the different points which should be mentioned in such a report. 20c.

5939—SILICON IN PIG IRON, Technical Determination of. Randolph Bolling. (Can. Min. Journ., March 15, 1908; 1¾ pp.) This discusses the compositions of pig iron and describes in detail the method of determining silicon used at the laboratory of the Nova Scotia Steel and Coal Co. 20c.

5940—VANADIUM in Cast Iron. Richard Moldenke. (Trans. Am. Foundrymen's Assn., Dec., 1907; 12 pp.) Describes a series of experiments to determine the effect of vanadium upon cast iron and gives the results of the different physical tests upon the test pieces. 20c.

5941—WURTEMBURG—Die Eisenerzlagerstätten Württembergs und ihre volkswirtschaftliche Bedeutung. R. Fluhr. (Zeit. f. prak. Geol., Jan., 1908; 23 pp.) A careful description of the nature and occurrence of iron ore in Wurtemburg, and a discussion of the importance of the ores to the iron smelting industry of the district. 40c.

LEAD

5942—BRITISH COLUMBIA—Lead Mining in British Columbia. (Brit. Col. Min. Rec., Dec., 1907; 2¾ pp.) The conditions at the more important lead-producing mines are reviewed; the production of the province is stated; the subject of the Dominion lead bounty is discussed. 20c.

5943—HISTORY AND DEVELOPMENT—Lead: Its History and Economic Development.—I. Evans W. Buskett. (Min. Wld., Mar. 14 and 21, 1908; 3 pp.) Some points' in early history of lead mining especially in the United States is mentioned and the properties of the metal, its ores and their manner of occurrence are described. The second instalment outlines the different methods of assaying and smelting lead ores. 40c.

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5945—MISSOURI—Zinc and Lead Deposits of Southwestern Missouri. F. Lynwood Garrison. (Min. and Sci. Press, Feb. 29, 1908; 3½ pp.) See under "Zinc."

5946—MISSOURI—Lead and Zinc Resources of Missouri. E. R. Buckley. (Proc. Am. Min. Congress, Nov., 1907; 16 pp.) See under "Zinc."

MOLYBDENUM

5947—DETERMINATION—A New Color Test for Molybdenum. William Bettel. (So. Afr. Mines, Feb. 1, 1908; ½ p.) A new quality test for molybdenum is described. This consists of adding a small quantity of ammonium hydrate to a slightly acid solution; if molybdenum is present, a brownish, red color will appear. 20c.

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5949—FUEL OIL—Crude Oil as Fuel. Wm. Chaddick. (Engineer, Mar. 2, 1908; 2 pp.) Some of the characteristics of American crude oils are stated, the flash test is described, the principles of feeding oil under boilers, the design of such furnaces, and different forms of oil burners are briefly discussed. 20c.

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5951—RUMANIAN PETROLEUM INDUSTRY During 1907. (Petrol. Rev., Mar. 14, 1908; 1½ pp.) Gives statistics of the amount of oil exported and states the relative importance of the different Rumanian oilfields. 40c.

PHOSPHATE ROCK

5952—FLORIDA—The Phosphate Industry of Florida. C. G. Memminger. (Paper read before Fla. Bankers' Assn., Feb. 21, 1908; 3 pp.) The history of the industry in Florida is reviewed; the character of the phosphate deposits and the production of the different countries and the guarantees regarding the chemical composition of the different commercial varieties of phosphate rock, are stated.

5953—TENNESSEE WHITE PHOSPHATE. (Am. Fertilizer, Feb., 1908; 5¾ pp.) Discusses the origin and extent of the phosphate deposits in the Wilsdorf district of Perry county and then briefly outlines the occurrence of phosphate in other districts of the State. 20c.

RARE METALS

5954—MONAZITE—The Occurrence, Production and Commercial Value of Monazite. C. D. Test. (Bull. Colo. Sch. Mines, Jan., 1908; 6 pp.) The uses of monazite and the general manner of occurrence are reviewed, and then the sources of the monazite used in commerce are stated. 60c.

5955—TANTALUM—Occurrence and Uses of Tantalum. (Bull. Imp. Inst., Vol. V, No. 4, 1907; 9 pp.) The minerals containing tantalum are described; the distribution of the ore deposits throughout the world outlined, and the physical properties and uses of tantalum discussed. 40c.

SALT

5956—CARMEN ISLANDS—The Saline Deposits of Carmen Islands. Edward H. Cook. (Eng. and Min. Journ., Mar. 14, 1908; 1¼ pp.) The geology of this island in the Gulf of California is described, and the method of working the deposits stated. 20c.

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5957—MEXICO—A Historic Sulphur Mine in Durango, Mexico. Douglas Muir. (Min. Sci., Feb. 27, 1908; 1¼ pp.) The sulphur deposits near Conejos in Durango are described, and the White steam process of obtaining the sulphur from the mined ore is outlined. 20c.

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5959—BOLIVIA—Northern Tin Fields of Bolivia. G. Preumont. (Min. Journ., Feb. 8 and 29, 1908; 1½ pp.) The topographic, climatic, and other conditions are described and the tin deposits of the Huayna-Potosi-Milluni and Araca districts discussed at some length. To be continued. 60c.

5960—REFINING—Notes on Tin—IV. A. Humboldt Sexton. (Mech. Engr., Feb. 21, 1908; 1¾ pp.) This instalment discusses the refining of the metal and the process in use at Cornwall. 20c.

5961 — TASMANIA — Re-organization at Mount Bischoff. (Min. Journ., Mar. 7, 1908; ½ p.) In this editorial the recent changes in tin dressing at this property in Tasmania are discussed. 40c.

5962—TASMANIA—Tin Mining in Tasmania. James B. Lewis. (Eng. and Min. Journ., Mar. 7, 1908; 4¼ pp.) Conditions at the Mount Bischoff, the Brookstead, the Heemskirk, the Avoca, the Blue Tier, and Briseis mines are reviewed as well as the conditions prevalent at the mines in the Gladstone and other districts of Tasmania. 20c.

ZINC

5963 — CONCENTRATION — Cañon City Plant of the Empire Zinc Company. (Mines and Mining, Mar. 6, 1908; 1¼ pp.) The method of concentrating zinc ores at this plant is described. 20c.

5964—MISSOURI—Lead and Zinc Resources of Missouri. E. R. Buckley. (Proc. Am. Min. Congress, Nov. 16, 1907; 16 pp.) The past production of Missouri is stated, the geology of the Ozark region described, the origin of the lead and zinc ores of the Joplin district is discussed, and estimates are given of the cost of different kinds of mining work in the Joplin district.

5865—MISSOURI—Zinc and Lead Deposits of Southwestern Missouri. F. Lynwood Garrison. (Min. and Sci. Press, Feb. 29, 1908; 3½ pp.) An interesting article on the genesis of the ore and the geology of the zinc and lead region of Missouri. Illustrated with photographs and map. To be continued. 20c.

5966—REVIEW OF PROGRESS—A Review of the Zinc Industry. H. M. Burkey. (Electrochem. and Met. Ind., Mar., 1908; 2½ pp.) The progress during the year in the methods of magnetic separation, of roasting, of electric smelting, and of lixiviation, as well as in the manufacture of zinc oxide and in galvanizing, is reviewed and a list of important articles on zinc, published during the year is given. 40c.

5967—TARIFF ON ZINC ORES. S. Duffield Mitchell. (Proc. Am. Min. Congress, Nov. 16, 1907; 20 pp.) The state of this controversy is reviewed in detail and the different cases that have been tried are discussed.

ECONOMIC GEOLOGY—GENERAL

5968—AFRICA—Les Dislocations du Bassin du Congo. J. Cornet. (Ann. de la Soc. Geol. de Belquque, Nov. 15, 1907; 8 pp.) Describes the geology of this section of Africa, with particular reference to the evidence afforded by the waterfalls.

5969 — ARKANSAS — INDIAN TERRITORY—Geologic Atlas of the United States Winslow Folio. A. H. Purdue. (U. S. Geol. Survey, 1907; 12 pp.) The geology of this area is described and the economic resources, which consist mainly of clay and limestone and some coal consumed entirely by local users, is outlined.

5970—BRITISH COLUMBIA—Alberni District, British Columbia. (B. C. Min. Exchange, Feb., 1908; 11¾ pp.) Valuable information regarding this section of Vancouver island, which is now being opened up by the Canadian Pacific Railway. From Bull. 24, issued by the Provincial Government. 20c.

5971—BRITISH COLUMBIA—Camp Hedley, Similkameen District. Charles Camsell. (B. C. Min. Rec., Jan., 1908; 6 pp.) This abstract of the paper in the "Summary Report of the Geological Survey Department of Canada for 1907," describes the topographic features, the general geology and the economic geology of the district. 20c.

5972—BRITISH COLUMBIA—Mineral Locations on Moresby Island, Queen Charlotte Group. Wm. F. Robertson. (B. C. Min. Rec., Feb., 1908; 9 pp.) An exhaustive report, dealing with the history, geology, climatic conditions and mining in this region. From Bull. No. 1, of the Brit. Col. Bureau of Mines. 20c.

5973 — BRITISH COLUMBIA — Powell River to Kingcome Inlet, and Adjacent Islands. J. Austen Bancroft. (B. C. Min. Rec., Feb., 1908; 2¾ pp.) A report of the geology of this district. Illustrated. From Summary Report of Geological Survey of Canada for 1907. 20c.

5974—BRITISH COLUMBIA—The Bulkley Valley District, in Skeena Mining Division. W. W. Leach. (B. C. Min. Rec., Feb., 1908; 7 pp.) A discussion of the topography and geology of this interesting district, covering both coal and metal mining. Illustrated. 20c.

5975—BRITISH COLUMBIA—The Lardeau District of British Columbia. R. W. Brock. (B. C. Min. Rec., Jan., 1908; 5¾ pp.) This abstract of the original paper in the "Summary Report of the Geological Department of Canada for 1907," describes the geology of the district and outlines the development done at different mines. 20c.

5976—CALIFORNIA—A Note on the Geology of the Coso Range, Inyo County, Cal. John A. Reid. (Journ. of Geol., Jan.-Feb., 1908; 9 pp.) The general geology of this range is described. 60c.

5977—CANADA—Summary Report of the Department of Mines. (Geol. Surv. of Canada, Sessional Paper No. 26, 1908; 132 pp.) Contains preliminary reports on the geology of many parts of Canada many of which contain mines. 20c.

5978—COLORADO—The Historical Development of Colorado Viewed from a Geological Standpoint. T. A. Rickard. (Min. and Sci. Press, Feb. 29, 1908; 3 pp.) Mentions first mining operations and subsequent discoveries, many of which were based on similarity of geological conditions. 20c.

5979—GERMAN NORTHWEST AFRICA—Die Erzlagerstätte von Tsumeb im Otavi-Bezirk im Norden Deutsch-Südwestafrikas. W. Maucher. (Zeit. f. prak. Geol., Jan., 1908; 8½ pp.) Outlines the geology of the country, describes the occurrence of copper, lead, antimony ores, discusses their origin and their marketability. 40c.

5980—ILLINOIS—The Geological Map of Illinois. (Second Edition.) S. Weller. (Ill. State Geol. Surv. Bulletin No. 6, 1907; 36 pp.) Presents a revised geological map of the State of Illinois, with many changes and additions. Very complete and comprehensive.

5981—MAGNETITES—On the Associations and Origin of the Nontitaniferous Magnetites in the Adirondack Region. D. H. Newland. (Econ. Geology, Dec., 1907; 11 pp.) The general geology of the region, the character of the ore and its mode of occurrence and the origin of the magnetites are discussed. 60c.

5982—MICHIGAN—Geologic Atlas of the United States—Ann Arbor Folio. L. C. Russell and F. Leverett. (U. S. Geol. Survey, 1908; 20 pp.) The geology of this area near Ann Arbor is described and the economic resources which consists of clays and building stones, are outlined.

5983—MINE WATER—Les Causes de la Haute Température des Eaux rencontries dans les Tunnels inclinés du Charbonnage de Baudour. V. Brien. (Ann. de la Soc. Geol. de Belgique. Nov. 15, 1907; 2½ pp.) A refutation of the proposed theory that the water in this mine is warmed by heat resulting from the oxidation of pyrites.

5984—NEVADA—The Post-Jurassic Igneous Rocks of Southwestern Nevada. Sydney H. Hall. (Journ. of Geol., Jan.-Feb., 1908; 12 pp.) The characteristics and occurrences of the post Jurassic but pre-Eocene igneous rocks are described. 60c.

5985—ORE DEPOSITION—A Theory of Ore Deposition. J. E. Spurr. (Econ. Geology, Dec., 1907; 14½ pp.) Discusses petrographic provinces, rock differentiation during crystallization, and the physical condition of rock magmas, and then outlines a new theory according to which metalliferous fluids from which the ores are precipitated, are extreme differentiation phases of rock magmas and the most striking chemical differences between ore deposits are due to successive precipitation in theoretically vertical zones. 60c.

5986—ORE DEPOSITION—Magmatic Differentiation in Ore Deposition. (Min. Sci., Mar. 19, 1908; 1¾ pp.) In this editorial the new theory of ore deposition, recently outlined by J. E. Spurr, is discussed. 20c.

5987—ORE DEPOSITS—On a Deficiency in the Nomenclature of Mineral Deposits. Henry Louis. (Trans. N. Eng. Inst. Min. and Mechan. Engrs., Feb., 1908; 3 pp.) In this article Prof Louis proposes to extend the use of the American mining term "pitch," and defines its meaning.

5988—ORE DEPOSITS—Present Tendencies in the Study of Ore Deposits. W. Lindgren. (Econ. Geology, Dec., 1907; 19 pp.) The recent suggestions regarding the origin of ore deposits are reviewed, the theory of igneous origin most popular at present is summarized, and a bibliography of important articles that have appeared in recent years is given. 60c.

5989—PERU—The Mining Possibilities of the Department of Cuzco, Peru. Enrique J. Duenas. (Min. Journ., Mar. 7, 1908; ¾ pp.) An article abstracted from the original in the *Boletin* del Cuerpo de Ingenieros de Minas de Peru, No. 53. In the first instalment the general geology and the economic geology of the region are described. To be continued. 40c.

5990 — YUKON TERRITORY — Between Whitehorse and Tantalus. D. D. Cairnes. (B. C. Min. Rec., Feb., 1908; 4 pp.) Report on the topography, geology and mining operations in this region. Illustrated. From Summary Report of Geological Survey of Canada for 1907. 20c.

MINING—GENERAL

5991—BLASTING—Loading a Hole with Dynamite. (Eng. and Min. Journ., Mar. 7, 1908; ½ p.) The proper way to load a hole with dynamite is discussed. 20c.

5992—BRAZIL — Bibliographia minerale Geologica do Brazil. M. A. R. Lisboa. (Extr. dos Annaes da Escola de Minas de Ouro Preto, Ns. 8 e 9, 1907; 62 pp.) This contains a complete bibliography of all articles relating to the mines and the geology of Brazil from 1903 to 1906.

5993—BRITISH COLUMBIA—Mining in the Kootenay Districts in 1907. (B. C. Min. Rec., Dec., 1907; 6½ pp.) The conditions in the Rossland, Clocan, Kootenay Lake, Lardeau, Nelson, Ymir, East Kootenay and Golden camps are reviewed. 20c.

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5996—BRITISH COLUMBIA—The Mineral Production of British Columbia in 1907. (Brit. Col. Min. Rec., Dec., 1907; 2¼ pp.) The conditions during the year in the Cariboo, Cassiar, East Kootenay, West Kootenay, Lilloet, Boundary, Yale and Coast districts are reviewed. 20c.

5997—CANADA—Mineral Production of Canada. (Eng. and Min. Journ., Mar. 21, 1908; 3 pp.) This is a summary of the preliminary official report prepared by John McLeish, under the direction of Dr. Eugene Haanel, director of mines, and gives statistics of the mineral production for 1907. 20c.

5998—CANADIAN MINING INSTITUTE. (Eng. and Min. Journ., Mar. 14, 1908; 2 1/3 pp.) The March, 1908, meeting is described in detail and a list of the papers presented at this meeting is given. 20c.

5999—DIAMOND DRILLING in the Boundary District, Notes on Cost of. Frederick Keffer. (Can. Min. Journ., March 15, 1908; 2¼ pp.) Discusses in detail the cost of diamond drilling at the British Columbia Copper Co.'s mine, and gives tables showing the principal factors entering into calculation of these costs. 20c.

6001—DRAINAGE in Cripple Creek, Colorado, Gold Camp. T. R. Countryman. (Min. Sci., Mar. 19, 1908; 1¼ pp.) The first instalment discusses the quantity, source and the early development of water in the mines and the theory of a common water level in the district. To be continued. 20c.

6002—EDUCATION—Mining Engineering Education in the United States. Victor C. Alderson. (Proc. Am. Min. Congress, Nov. 16, 1907; 10 pp.) The institutions in the United States offering mining instruction are stated; the present status of mining education, and the range of instruction that should be covered are discussed.

6003—EDUCATION—Secondary Technical Education Applied to Mining. Lewis Young. (Proc. Am. Min. Congress, Nov. 16, 1907; 7 pp.) Discusses different methods of offering technical instruction to practical mining men.

6004—EDUCATION—Some Suggestions Concerning the Training of Mining Engineers. Robert Peele. (Proc. Am. Min. Congress, Nov. 16, 1907; 10 pp.) Discusses the instruction at present given at mining schools, reviews the results claimed and suggests some changes that might be made in the instruction.

6005—EDUCATION—The Value of Correspondence Instruction to the Mining Man. H. H. Stoek. (Proc. Am. Min. Congress, Nov. 16, 1907; 16 pp.) Discusses the results attained by such instruction.

6006—EDUCATION—What Can the Profession Really Expect from the Mining School Graduate? Milnor Roberts. (Proc. Am. Min. Congress, Nov. 16, 1907; 6 pp.) The nature of the instruction given at most mining schools is discussed and the fields of work open to young graduates are suggested.

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